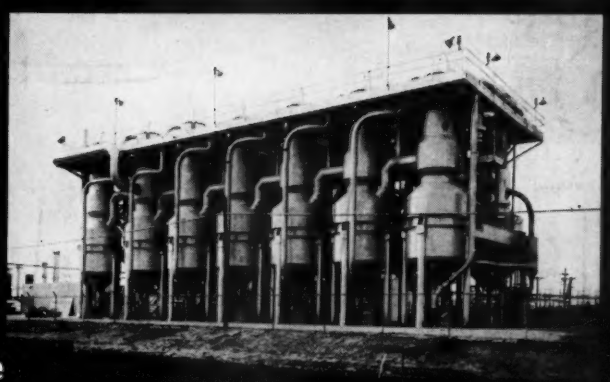
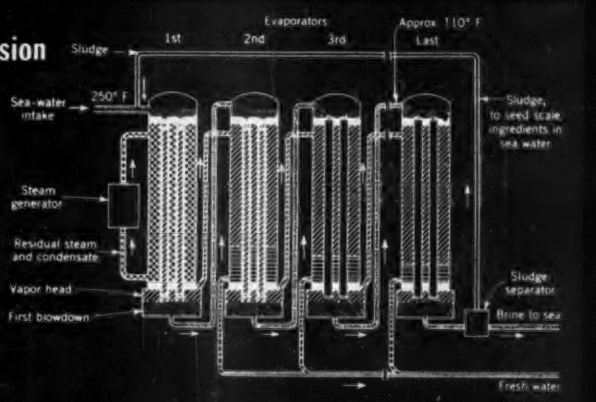
CIVIL ENGINEERING

THE MAGAZINE OF ENGINEERED CONSTRUCTION • DECEMBER 1961

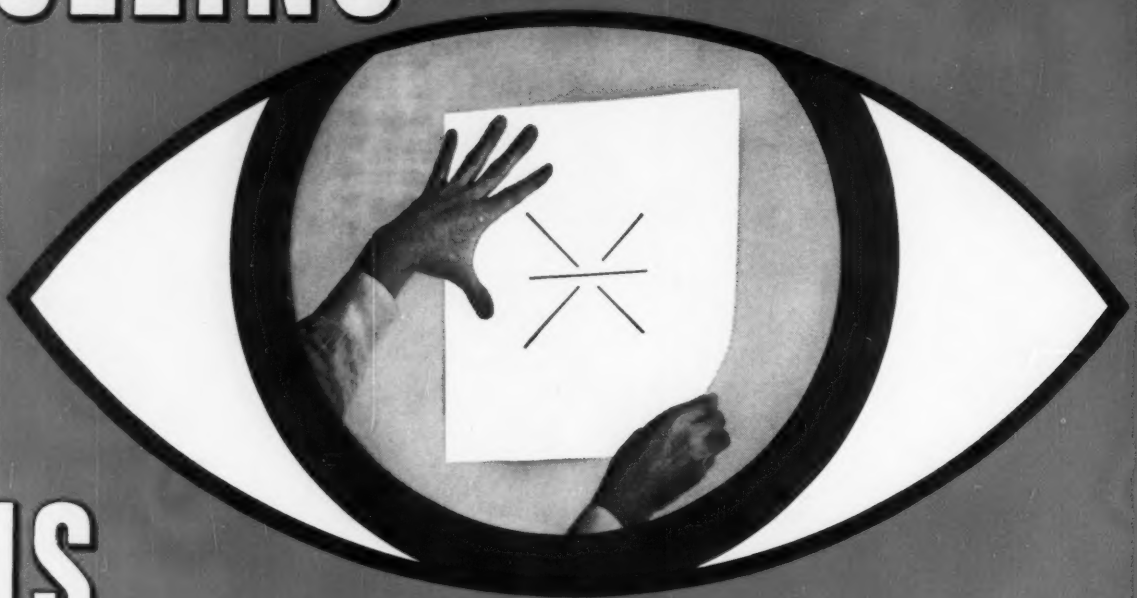


Saline water conversion



AMERICAN SOCIETY OF CIVIL ENGINEERS
FOUNDED 1852

SEEING



IS BELIEVING!

to prove it's best make the Clearprint test

See for yourself why leading engineers and architects demand Clearprint Technical Papers. Ask for a sample, then make this convincing test:

1. INVITES THE PENCIL
   Try Clearprint's perfect working surface with a 2H pencil, then with a ruling pen. Lines are sharp and clean—no feathery edges.
2. HIGHEST ERASING QUALITIES
   NO GHOSTING — Erase some of the lines. Redraw and erase several of them time and again. Crease the paper, too. Then hold it to the light, or make cleanest possible reproductions.
3. NEVER CHANGES
   Sheets in use for 27 years prove Clearprint's amazing stability. Its strength, transparency and printing qualities remain unchanged after extended exposure to age, atmosphere, heat and light. ITS COLOR DOES NOT CHANGE.

If you are not using Clearprint now, please make this comparative test on the paper you are using.

CLEARPRINT®

"FADE-OUT" PAPER T.M.
TECHNICAL PAPER
FORMS • CHARTS • GRAPHS
"PRE-PRINT" PAPER T.M.
THERE IS NO SUBSTITUTE
Clearprint is Watermarked For Your Protection

15

CLEARPRINT PAPER CO. CE-1560
1482 - 67th St., Emeryville, Calif.

☐ Send me Clearprint Fade-Out samples, with prices, for the following uses:_____

Name_____

Firm_____

Address_____

City_____ Zone___ State_____

5

Toronto's new airport in the round

This is the way Toronto International Airport will look with all four aeroquays in operation. The second floor is the main level of the aeroquay. It contains the ticket lobby, shops, lounge, coffee shop, and departure areas, as well as observation decks. John B. Parkin Associates, Consulting Architects and Engineers to the Department of Transport, H. J. Connolly, Director of Construction Branch, W. A. Ramsay, Chief Architect. *General Contractor:* Foundation Company of Canada, Ltd.

As adaptable as the steel that frames it, Toronto International Airport is designed to grow as jet traffic grows

Steel *for Strength ... Economy ... Versatility*

Toronto's new terminal calls for a central administration building surrounded by four aeroquays. These aeroquays will house all the passenger facilities and operations of the domestic and foreign airlines flying in and out of Toronto.

Shaped like a doughnut, each steel-framed aeroquay will be two buildings in one, 660 feet in diameter. A roadway system will lead vehicles, by underpasses under the aircraft apron, directly to these airline buildings.

The first aeroquay is scheduled for completion in 1962. Sites for three others are available, and these aeroquays will be built as needed.

All-welded steel framework

All connections in the shop were welded. For just the 6,000 tons of column sections with welded cover plates, York Steel Construction welded some 40,000 lineal feet of steel. All rigid connection plates were field welded to the column sections at the site.

Steelwork erected in dead of winter

To maintain weld quality in frigid weather, York Steel Construction pre-heated and post-heated the steel, using mobile banks of oxygen and propane. All welds were ultrasonically tested at the site; no failures were reported. Although the winter was severe, only 3½ weeks of erection time were lost to the bad weather.

15,000 tons in under 180 days

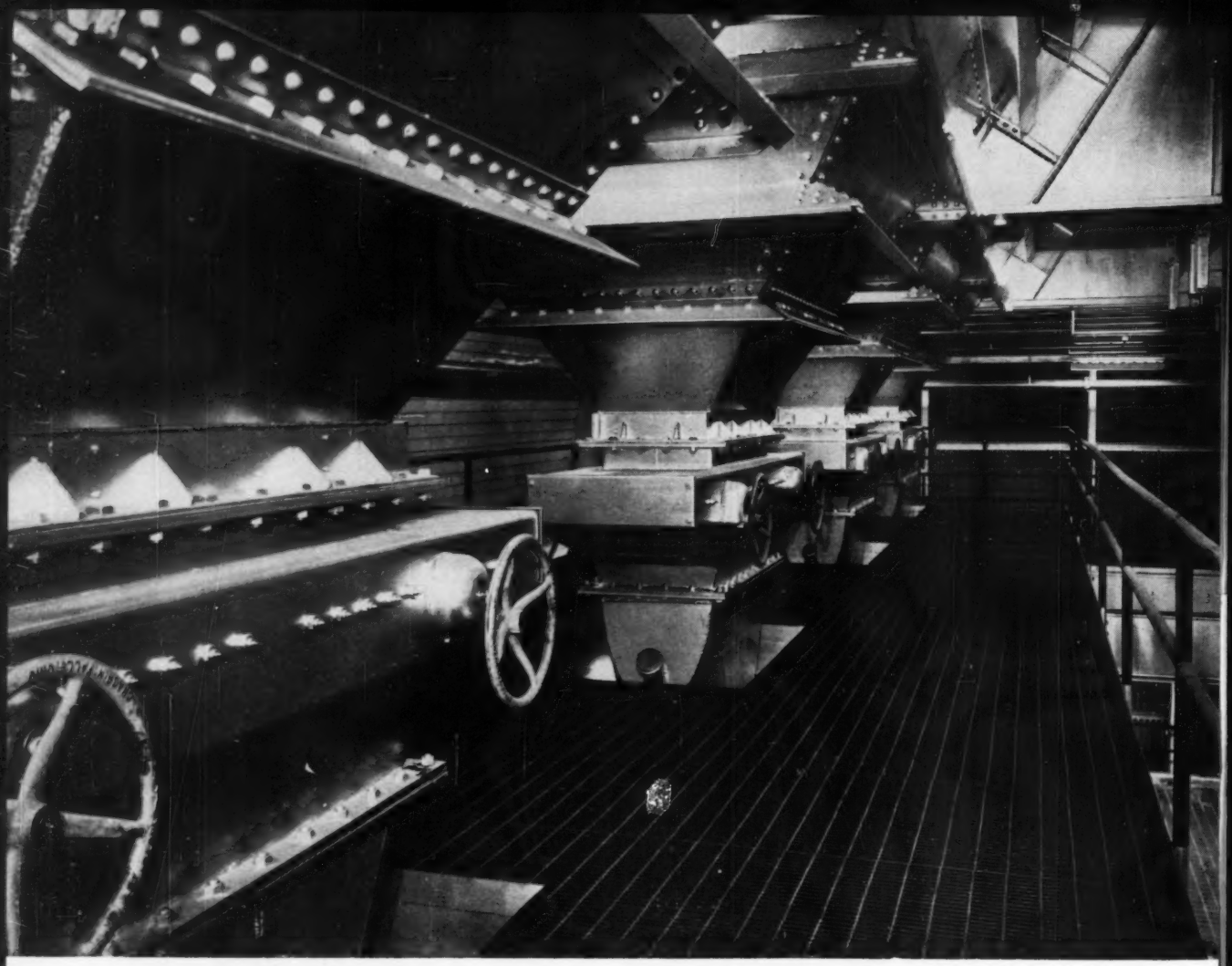
York Steel fabricated and erected some 15,000 tons of shapes and plates for aeroquay No. 1. All steel went up in under 180 days. Bethlehem supplied 9,803 tons of wide flange, and 196 tons of plates. The balance of the tonnage was obtained from Canadian sources.

Steel framework of aeroquay No. 1. *Steel Fabricator and Erector:* York Steel Construction, Ltd.

BETHLEHEM STEEL COMPANY, BETHLEHEM, PA. *Export Sales:* Bethlehem Steel Export Corporation

BETHLEHEM STEEL

BETHLEHEM STEEL



CIVIL ENGINEERING, December 1961, Vol. 31, No. 12 • Published monthly by the American Society of Civil Engineers. Publication office Concord, New Hampshire. (Second class postage paid at Concord, New Hampshire.)

CIVIL ENGINEERING

DECEMBER 1961

VOL. 31 • NO. 12

THE MAGAZINE OF ENGINEERED CONSTRUCTION

• *ARTICLES*

T. N. Tate 33 **World's largest drydock**
Frank Schneller 38 **Where we stand on saline-water conversion**
G. D. Friedlander 44 **A center for shockproof shopping**
52 **Sonic pile-driving shows promise**
Jerry C. L. Chang 53 **Orthotropic-plate construction for short-span bridges**
David P. Billington 56 **Thin-shell structures**
Samuel A. Greeley 60 **Water resource and pollution control legislation**
Ernest C. Fortier 65 **Cast-in-place concrete pipe cuts time and costs**
Ralph L. Bloor 68 **World Bank money for engineering and construction**
Russell Aschinger 70 **Automatic welding for a stadium addition**
William W. Moore, Chairman 72 **Professional practice of soil mechanics and foundation engineering—Task Committee report**

• *ASCE NEWS*

48, 78 **ASCE news sections**
48 **United Engineering Center is dedicated**
49 **ASCE takes part in Conference on Fundamental Research in Plain Concrete**
50 **Houston the host for next Convention**
51 **ASCE Student Chapter Scholarships offered**
78 **ASCE adopts policy statement on surveying**
78 **Hoover Medal presented during UEC dedication**
79 **Division Doings**
81 **Notes from the Local Sections**
86 **The Younger Viewpoint**
88 **Byline Washington**

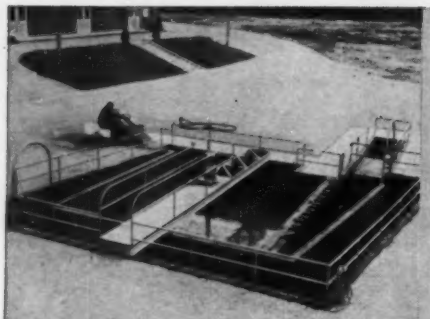
• *NEWS BRIEFS*

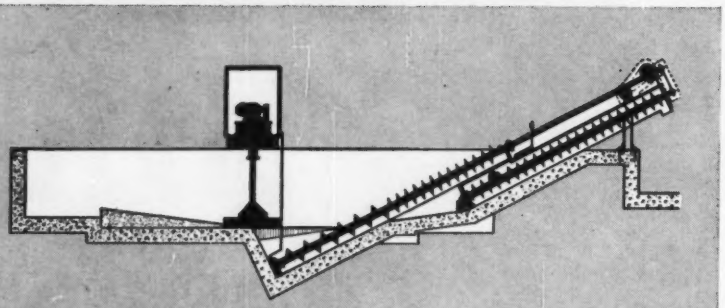
94 **Water Pollution Control Federation has annual meeting**
95 **Construction declines slightly in October**
96 **First report on AASHO Road Test is released**

• *DEPARTMENTS*

16 News of Members
29 Am-Soc Briefs
31 Do You Know That
73 The Readers Write
80 Salary Index of ASCE
84 Scheduled ASCE Meetings
98 Exam Gems
102 Deceased
108 New Publications
110 Applications for Membership
110 Positions Announced
111 Non-ASCE Meetings
112 Recent Books
113 Equipment, Materials, Methods
117 Literature Available
119 From the Manufacturers
120 Men and Jobs Available
128 Index to Advertisers

122 PROCEEDINGS papers available





EIMCO-PROCESS Type DSB Grit Separator

OTHER EIMCO-PROCESS PRODUCTS FOR SEWAGE & INDUSTRIAL WASTES

OXIGRITTER Treatment Units

Combine pre-aeration, grit removal and clarification. Separations 65 to 200 mesh sand particles can be made.

CLARI-THICKENER Units

Clarification and sludge thickening in one multi-purpose unit. Eliminates need for separate sludge thickening unit.

OXIDATOR® Treatment Units

Combine aeration, flocculation and sedimentation in a single tank, provides adjustable sludge recirculation rates and controlled sludge thickening.

ROTARY DISTRIBUTORS

Standard and high rate types for all bed sizes. Designed to handle widely varying flows with minimum head loss.

AEROBIC DIGESTION PLANTS

Complete plants for low-cost treatment of small flows, 1,000 to 300,000 GPD, with minimum investment in equipment.

EIMCOBELT® Filters

Continuous belt filters for dewatering sewage sludge.

Improved Grit Washing . . . Better Organics Removals – with Washer Inside the Collection Tank!

Eimco-Process Type DSB Grit Separator, for large flows or deep collection tanks, has two spiral washers in series, the lower discharging into the washer trough of the upper. Grit is retained and scoured in the lower end of the upper screw by interrupted spiral flights for additional removal of organics. Both spirals driven by one drive.

- No dead spaces. Floating putrescibles can't accumulate, with spiral screw washer on the inside of the collection tank. No scum hosing. Movement of sewage across grit pocket reduces amount of organics that can deposit with the solids to a minimum. No odor or fly nuisance.
- Variable speed drive accommodates wide variations between minimum and maximum flows . . . keeps organics from dropping out with the grit at low flows. Speed of grit collector mechanism is varied inversely with the velocity of the flow in the collection compartment.
- Cleaned, washed grit is elevated sufficiently high above outlet for convenient disposal.

Eimco-Process also builds Type SB Grit Separators, with single screw washer for small flows or shallow tanks. The Eimco-Process representative in your area will be glad to discuss good housekeeping in grit separation with you and your consulting engineers. Call him, and write Eimco's Process Engineers Division for Bulletin PV-1007.

Oxigritter, Clari-Thickener, Oxidator, EimcoBelt are trademarks of The Eimco Corporation.

EIMCO

"Advanced Engineering and Quality Craftsmanship Since 1884"

Process Engineers Division
420 Peninsular Avenue,
San Mateo, California

B-787

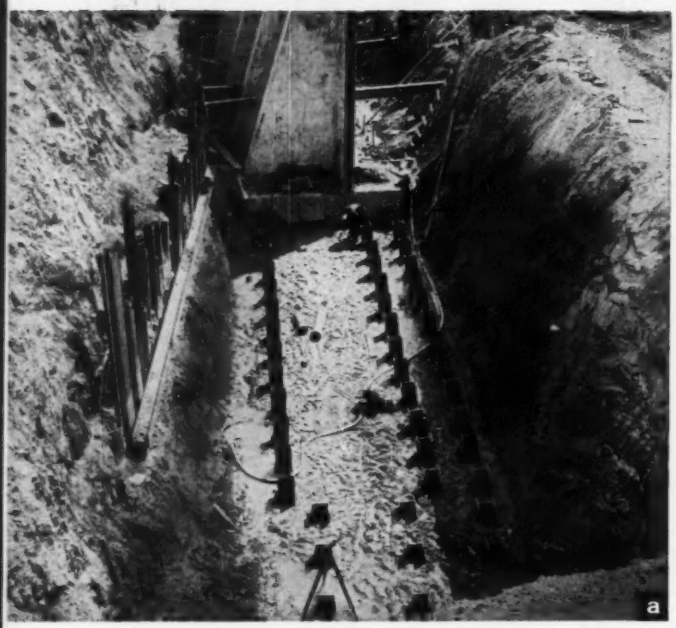
When Georgia was still a British Crown Colony in 1775, an act was passed that authorized a tax on all male inhabitants within the "road age," sixteen to sixty. This was the first official act put into effect in the South pertaining to overland transportation. Not long after that, all males within the "road age" in the state were called upon to work on their local roads from five to fifteen days per year. Today, over 200 years later, the work is still in progress on Georgia's highways, but now, instead of Colonial settlers, huge earthmoving machines and skilled engineers are building hundreds of miles of brand-new highways. The "Interstate Age" has replaced the "road age" in Georgia. For a report on Georgia's Interstate Highway Program, turn the page.

Georgia's highway program has a steel foundation

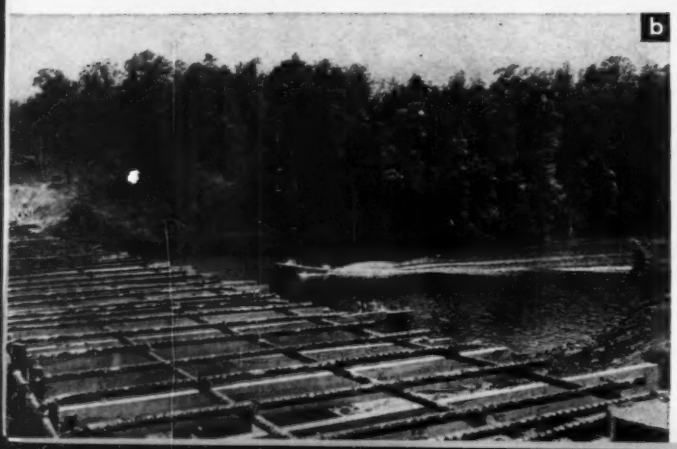
In Georgia, 1,107 miles of Interstate roads have been authorized by the Bureau of Public Roads. Completed to date: 122 miles with 208 miles now under construction. 1,200 bridges will be needed to complete the system, with 290 already done. Responsible for this gigantic project are Jim L. Gillis, Sr., chairman, Georgia State Highway Board, and M. L. Shadburn, chief highway engineer. When Georgia's highway construction is completed, every foot of the roadway will be stronger and last longer because of the part played by U. S. Steel products in their construction. When the first ground is broken, power equipment built with USS High Strength Steels will take big bites out of the countryside. Contractors will move more earth per dollar because these strong steels last longer, weigh less and are stronger for greater efficiency and economy. Trucks, bulldozers, tractors, shovels—all the heavy equipment needed to build a modern highway—operate better because of these modern steels.

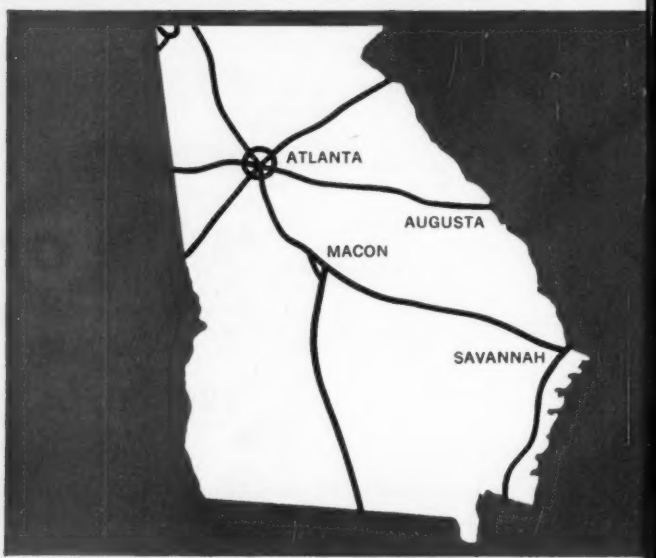
The long ribbons of concrete and the bridges that span Georgia's many rivers and streams along the Interstate routes are given extra durability by USS Highway Products. USS AMERICAN Welded Wire Fabric and USS DI-LOK Reinforcing Bars add stamina to the roadway. Paving is done smoothly with USS UNIVERSAL and ATLAS Cement products. Thousands of tons of USS Structural Carbon Steel and USS Steel H-Piles give bridges needed strength and permanent support. Galvanized corrugated steel culverts provide economical and dependable drainage. Strong, long-lasting USS CYCLONE Fencing, USS Highway Beam Guardrail and big, easy-to-read steel signs are all-important safety factors along Georgia's new highway system.

Here are a number of USS Highway Products in action: **a.** USS H-Piles will support this bridge. Their advantages include high load-carrying capacity and the ability to penetrate to firm strata where other pile types would be damaged or destroyed in driving. **b.** USS DI-LOK Reinforcing Bars strengthen the flooring and piers of this bridge. DI-LOK Bars are specially


a

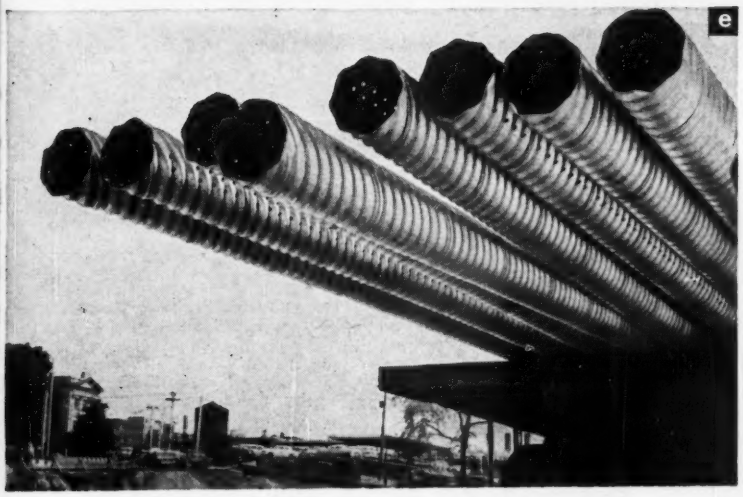

c


b



designed with a continuous diamond-locking conformation to insure positive anchorage, inhibit longitudinal movement of bars, and strengthen the bond between concrete and bridge. **c.** Earthmoving equipment must operate at full capacity and at high speeds to pay its way. U. S. Steel has developed a number of special steels for construction equipment that reduce over-all weight and provide excellent resistance to abrasion and shock. In trucks, graders, bulldozers—all the giant machines that build our roads today—USS "T-1" Constructional Alloy Steel, USS TRI-TEN, MAN-TEN and COR-TEN High Strength Steels improve performance and reduce expensive downtime. USS TIGER BRAND Wire Rope is strong and long-lasting, and enables buckets and cranes to operate for long periods without costly replacement. **d.** Interstate Highways are safer ways with strong USS Highway Guardrail. It is built extra-strong to withstand terrific impacts, and requires minimum maintenance. Steel's great strength and ease of installation make it an ideal highway investment. **e.** USS Galvanized Culvert Sheets, for instance, are ideal for installations carrying heavy loads over shallow fill because they are flexible, deflect under loads and gain support from the fill around them. Steel drainage products are more economical because they are delivered to the job ready for quick installation and service. They last for years because they are heavily zinc-coated for extra corrosion resistance. **f.** Easy-to-read signs are a must on high-speed Interstate roads. U. S. Steel provides many of the products for long-lasting, low-maintenance signs and markers. USS VITRENAMEL Sheets for porcelain-enameled signs provide maximum visibility and strength but require little or no maintenance. A passing shower washes them clean. Where *maximum* strength, economy and long life are important, steel fills the bill. USS Blast Furnace Slag makes an ideal roadbed foundation. It is economical, packs quickly and permanently, and provides an excellent bond for concrete. It has high resistance to weather action. USS Blast Furnace Slag weighs less than other types of aggregate and will yield a greater yardage of pavement for a given unit of weight. USS, AMERICAN, CYCLONE, DI-LOK, UNIVERSAL, ATLAS, TIGER BRAND, COR-TEN, TRI-TEN, MAN-TEN, VITRENAMEL and "T-1" are registered trademarks.

USS **United States Steel**



This mark tells you a product is made of modern, dependable Steel.

United States Steel Corporation
Room 6407, 525 William Penn Place
Pittsburgh 30, Pennsylvania

1. Please send me your booklet, "Keep Our Roads on the Go."
2. I would also like to have more information on the products checked:

- ☐ Reinforcing bars
- ☐ Structural steel shapes
- ☐ Right-of-way fencing
- ☐ Signs and sign supports
- ☐ Lighting standards
- ☐ Bridge rail
- ☐ Guardrail
- ☐ High strength steels
- ☐ Constructional alloy steels
- ☐ Culvert sheets
- ☐ Steel H-piles
- ☐ Steel sheet piling
- ☐ Slag products
- ☐ Welded wire fabric (paving)
- ☐ Welded wire fabric (structural)
- ☐ Wire rope
- ☐ Cement products

Name_____

Company_____

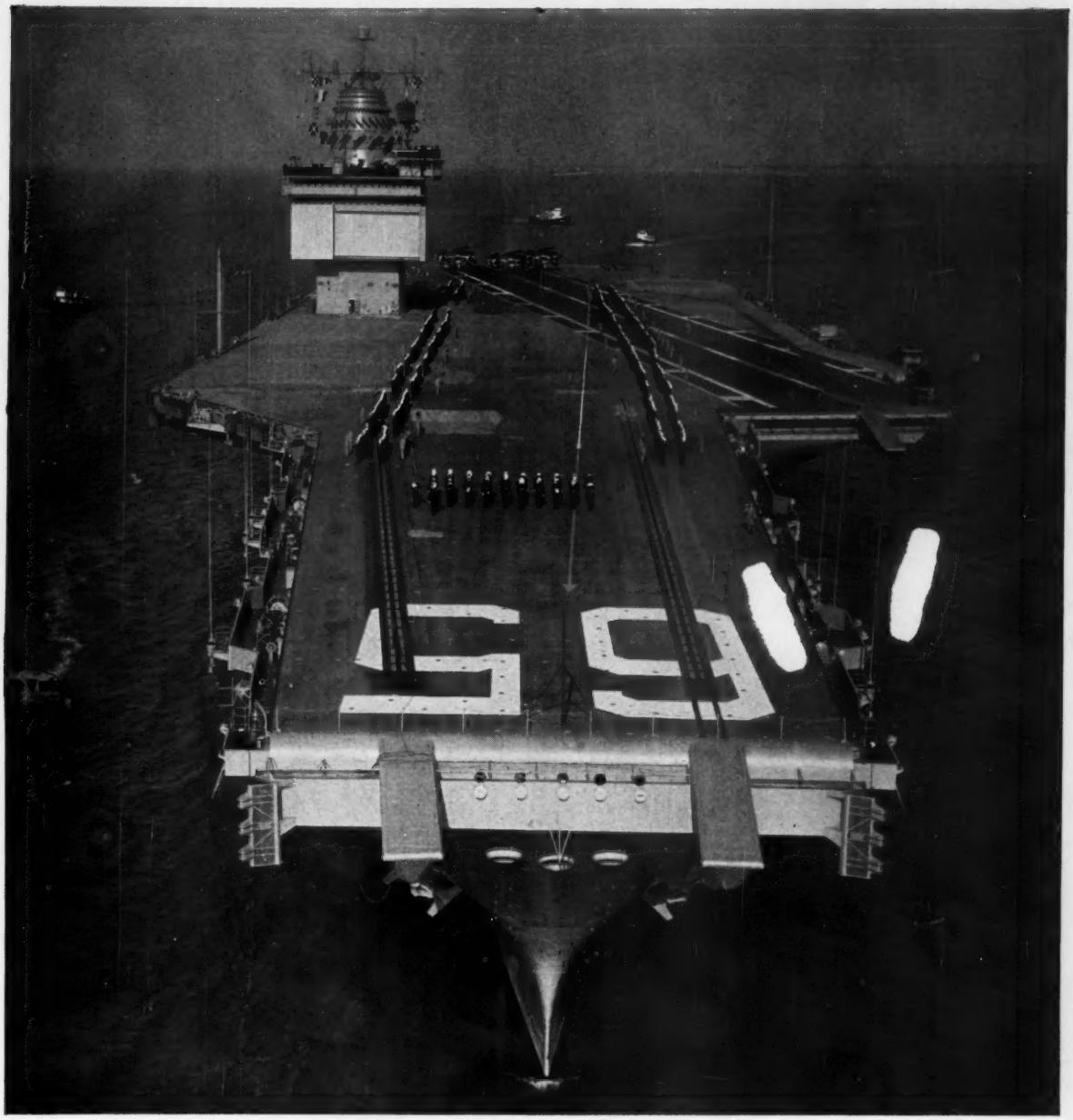
Title_____

Address_____

City_____ Zone____ State_____

The highway market is also served by the following divisions of United States Steel: American Bridge Division • American Steel and Wire Division Columbia-Geneva Steel Division • Consolidated Western Steel Division National Tube Division • Tennessee Coal and Iron Division • Universal Atlas Cement Division • United States Steel Supply Division.

USS **United States Steel**



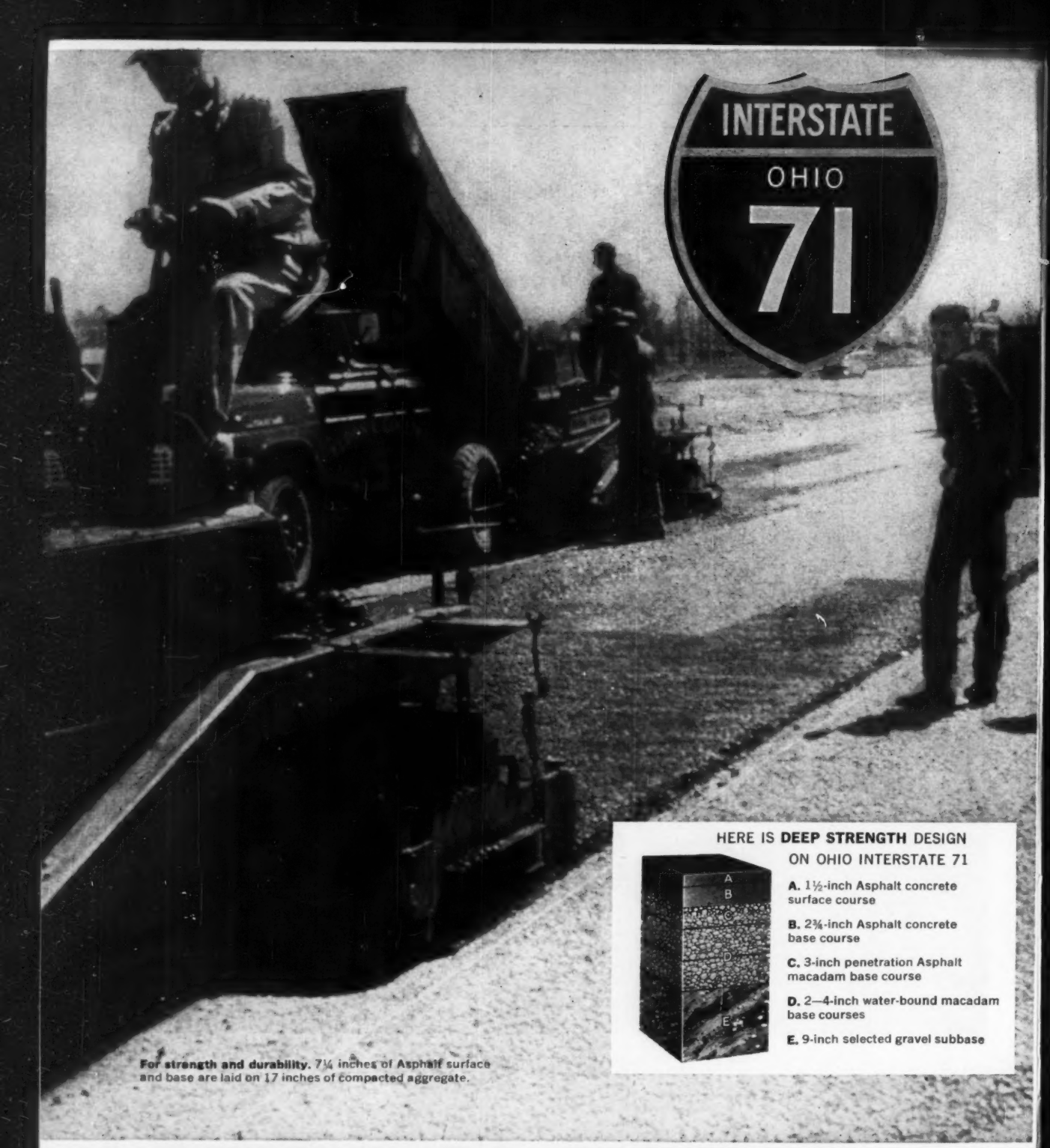
ENTERPRISE . . . at NEWPORT NEWS
a word with a double meaning!

To most people, it means the world's first nuclear-powered aircraft carrier. To us at the Shipyard, it means the energy, imagination and resourcefulness that delivered the great *Enterprise* nine weeks ahead of schedule—in many months less time than was taken to build some non-nuclear ships of her type.

Because of her eight reactors and extensive electronic system, no shipbuilding job was ever more complex. For 1,366 days, many constantly-changing challenges were met and surmounted. How well the men, methods and machines of Newport News discharged their responsibility for building the world's largest ship is now a matter of public and official record.

This is *enterprise at Newport News* . . . leader in shipbuilding and in the manufacturing of water power and other heavy industrial equipment.

Newport News
SHIPBUILDING AND DRY DOCK CO. NEWPORT NEWS, VIRGINIA



For strength and durability. 7¼ inches of Asphalt surface and base are laid on 17 inches of compacted aggregate.

HERE IS **DEEP STRENGTH** DESIGN ON OHIO INTERSTATE 71

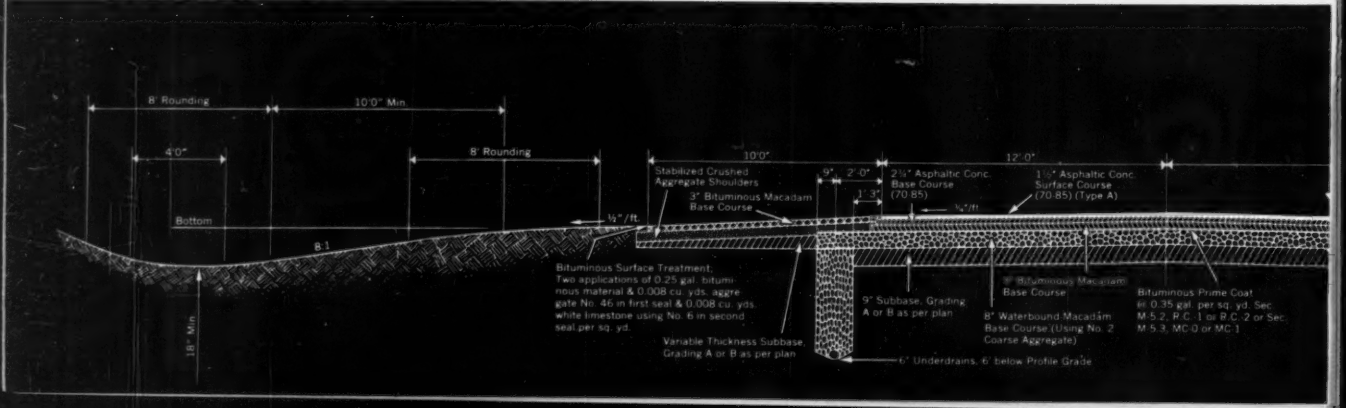
A. 1½-inch Asphalt concrete surface course

B. 2¾-inch Asphalt concrete base course

C. 3-inch penetration Asphalt macadam base course

D. 2—4-inch water-bound macadam base courses

E. 9-inch selected gravel subbase



New Section of Interstate 71:

First DEEP STRENGTH Asphalt Paved Interstate Highway in Ohio!

Traffic is now rolling on the first DEEP STRENGTH Asphalt paved Interstate Highway in Ohio. Serving a highly industrialized area, this new 17-mile section of Interstate 71 will be subjected to heavy freight traffic.

That's one reason why Ohio State highway engineers chose DEEP STRENGTH Asphalt pavement. Notice in the cross-section drawing (below) how design follows precepts of DEEP STRENGTH Asphalt construction . . . heavy-duty Asphalt concrete surface course . . . heavy-duty Asphalt base . . . Asphalt primed subbase . . . **depressed median and deep longitudinal drain on outside and inside shoulders for good drainage** . . . heavy proof-rolling of subbase . . . and use of high-contact pressure pneumatic proof-roller on all other courses. HERE IS STRENGTH AND DURABILITY!

When built like this—for DEEP STRENGTH—Asphalt pavements will carry heaviest traffic loads without distress . . . and with minimum maintenance cost.

And, most important, Asphalt pavements built to this Advanced Design Criteria can often save money over the cost of Asphalt pavement designed to other standards. That's because the Advanced Design Criteria permit inexpensive Asphalt base to be substituted, within limits, for more expensive Asphalt concrete surfacing, and allow reduction in total structure thickness when used in place of untreated base.

NEW HANDBOOK! A new edition of the *Asphalt Handbook* incorporating all the Advanced Design Criteria implied by the term DEEP STRENGTH Asphalt pavement is now available. Write to The Asphalt Institute.

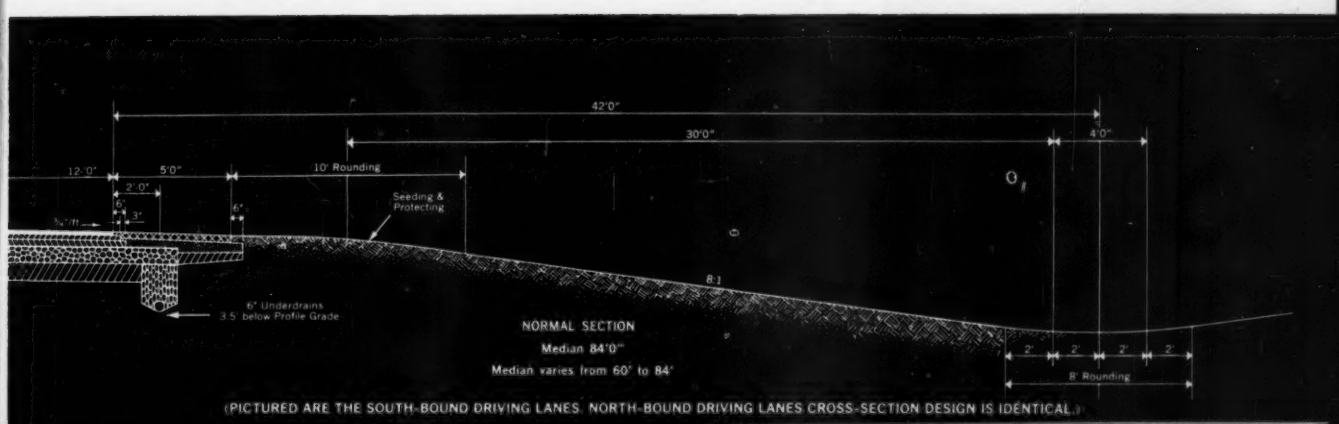
New DEEP STRENGTH Asphalt section extends northeast paralleling existing U. S. Route No. 42.

For smoother riding, the subbase was proof-rolled with a 50-ton compactor using tire pressures of 150 psi. A 30-ton rubber-tire compactor with tire pressures of 120 psi was used on all other courses.

For good drainage, section was designed with a depressed median and a system of deep longitudinal drains on each side of travel lanes to prevent water from entering the foundation courses.

THE ASPHALT INSTITUTE

Asphalt Institute Building, College Park, Maryland



(PICTURED ARE THE SOUTH-BOUND DRIVING LANES. NORTH-BOUND DRIVING LANES CROSS-SECTION DESIGN IS IDENTICAL.)

Mixing and placing a Cationic Bitumuls "mat" with a Moto-Paver. Note how closely the roller follows the paver.

This is a completed Cationic Bitumuls Drag Seal Job.

North Carolina forces apply cover aggregate to a Cationic Bitumuls Split Seal on 8.1 miles of State Highway.

CATIONIC BITUMULS NOW USED BY 21 STATE HIGHWAY DEPARTMENTS

Here's why:

1. **Fast Initial Set even in adverse weather.**
2. **Better Adhesion even with "hard-to-coat" stone.**
3. **"Rain-Proof" Coating of Aggregate (resists wash-off in sudden showers.)**

Since 1958, when we first introduced Cationic Bitumuls, it has gained steadily in acceptance by State Highway Engineering Departments all across the nation. Now, in twenty-one of our fifty states this material is in actual use. It is being tested and evaluated by many more.

Here's how one State took to Cationics

In 1958, The State Highway Commission of North Carolina took delivery of 100,000 gallons of Cationic Bitumuls so that one of their fourteen Divisions could do experimental work. When the results were evaluated here's what they found:

1. Early rains didn't damage the work.
2. The roads could be opened to traffic sooner.
3. The surfaces held more cover stone.

Based on these performance reports, the Commission made Cationic material available to all fourteen Divisions. In 1959, they used a total of 4,000,000 gallons. Last year (1960) 8,500,000 gallons!

How Cationic Bitumuls is used in North Carolina

North Carolina uses Cationic Bitumuls for two basic types of work: Split Seal, Drag Seal (Double Surface Treatments), Single Seal, Triple Surface Treatments; and Moto-Paver Mixes. Aggregates used vary from one area to another but the principal ones are gravel, granite, slate and limestone. Cationic Bitumuls performs uniformly well with all of these.

Cities, too, adopt Cationics

Many cities in North Carolina have switched to Cationic Bitumuls for much of their street and road work, profiting by the experience of the State Commission.

This same process is going on all across the country as more and more engineers become familiar with the high-level performance of Cationic Bitumuls.

If you have not had an opportunity to check a Cationic Bitumuls job in person, call our nearest office. A Bitumuls Engineer will arrange for you to visit a job near you.

American Bitumuls & Asphalt Company

320 MARKET ST., SAN FRANCISCO 20, CALIF.
Perth Amboy, N. J.
Baltimore 3, Md.
Cincinnati 38, Ohio
Atlanta 8, Ga.
Mobile, Ala.
St. Louis 17, Mo.
Tucson, Ariz.
Portland 8, Ore.
Oakland 1, Calif.
Inglewood, Calif.
San Juan 23, P. R.

BITUMULS® Emulsified Asphalts • CHEVRON® Paving Asphalts • LAYKOLD® Asphalt Specialties • PETROLASTIC® Industrial Asphalts

VIBROFLOTATION®
for Saturn Rocket Facility

Architects & Engineers: Maurice H. Connell & Associates, Miami, Florida
General Contractor: Henry C. Beck Company, Palm Beach, Florida

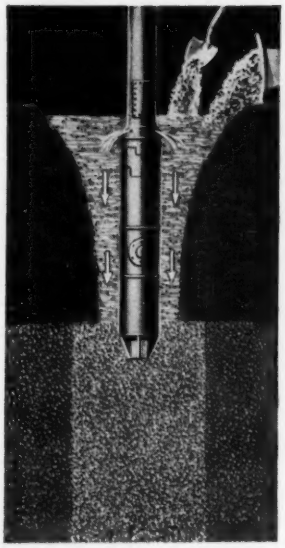


Diagram shows the lower end of a Vibroflot® machine in action to presettle sandy soil. Compaction is accomplished by a simultaneous saturation and vibration of the granular materials involved. During the application, fresh sand is added at the surface to compensate for the loss in volume caused by the increase in density (bearing capacity) of the compacted soil.

The foundation of Saturn Rocket Launching Facility, Complex 34, at Cape Canaveral was built on sand compacted by Vibroflotation for the U. S. Army Engineer District, Jacksonville, construction agency for NASA.

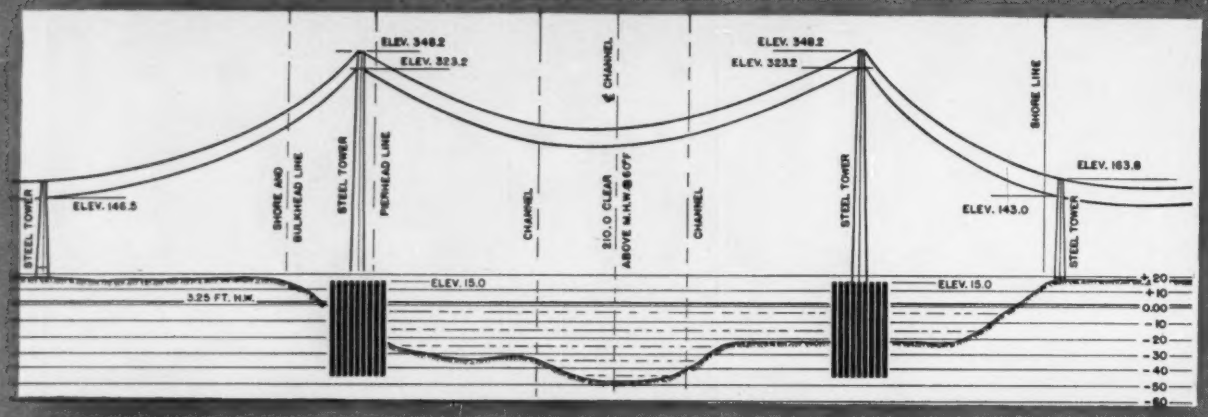
About 7000 cu. yds. of fresh sand were added during compactions to an average depth of 28 feet to achieve a uniformly dense foundation.

Now, Vibroflotation is being used on Complex 37 at Cape Canaveral.

Write for Booklet C-32

VIBROFLOTATION FOUNDATION CO.

930 FORT DUQUESNE BOULEVARD, PITTSBURGH 22, PA.



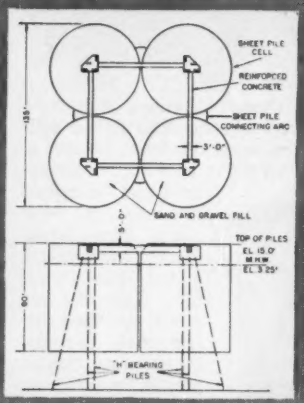
Ships Ahoy . . . steel islands ahead

The Delaware River is 4,200 feet wide at the spot where Philadelphia Electric Company wanted to build its new 220,000-volt transmission-line crossing near Chester, Pennsylvania. Clearances for air and river traffic limited sag, restricting the span to 2,800 feet, which meant off-shore suspension towers and danger from heavy river traffic.

Philadelphia Electric engineers came up with this novel solution: build their own islands with steel sheet piling cells, filled with sand and gravel. These piling islands would offer good basic protection to the towers and also provide a working platform for construction and maintenance.

Each island consists of four 67′-diameter cells interconnected by short arc walls. Tower legs are individually supported on clusters of four steel

for maximum strength and durability



H-Piles driven to 90-ton bearing on rock. A total of 1,850 tons of USS steel sheet piling in sections MP-101 and MP-102 were required.

This foundation was designed on the basis that a cell could be destroyed without endangering the tower, although the islands are well out of the ship channel as shown by the plan at the upper left.

In support structures like this, steel sheet piling and H-Piles do the very best job, and at the lowest cost. Wherever you are building, you can get any type of piling when you want it from United States Steel. Just call our nearest office. For technical information write United States Steel, 525 William Penn Place, Pittsburgh 30, Pennsylvania.

United States Steel Corporation • Columbia-Geneva Steel Division
National Tube Division • Tennessee Coal and Iron Division • United States Steel Export Company

USS TRADEMARK **United States Steel**

NEWS OF MEMBERS

Rolf Eliassen, currently in charge of the sanitary engineering phase of the water resources program at Stanford University and a member of Stanford's Institute in Engineering-Economic Systems, has been named a resident partner in the new Palo Alto, Calif., office of Metcalf & Eddy. Recognized internationally for his research in water treatment and radioactive wastes disposal, Dr. Eliassen was head of the sanitary engineering program at the Massachusetts Institute of Technology for some 12 years, professor at the Illinois Institute of Technology and New York University, consultant to the International Atomic Energy Agency in Vienna, the World Health Organization in Geneva, the U.S. Public Health Service, the Department of Defense, the White House Office, many state and municipal agencies, as well as president of Rolf Eliassen Associates, Inc.

Don M. Corbett is retiring after more than 36 years of continuous service with the U.S. Geological Survey to become a consultant on water resources investigations and watershed problems, at 3419 North Pennsylvania Street, Indianapolis 5, Ind. Throughout, Mr. Corbett has served the Survey in important administrative posts, such as principal assistant to the district engineer for the New England states of New Hampshire, Vermont, Rhode Island, and Massachusetts; as district engineer of Michigan and Indiana and, from 1951 to 1960, as district engineer of the Surface Water Branch in Indiana. He is author or co-author of more than 50 papers and manuals for the Survey, including a recent hydrologic handbook for the State of Indiana.

John L. Sally, after one year as design engineer in the fabrication division of the Peden Steel Company of Durham, N.C., was promoted recently to sales manager of that division. Mr. Sally, prior to 1960, was engineer with another Durham firm, H. Raymond Weeks, Inc.

Harold J. McKeever, long-time member of the Gillette Publishing Company editorial staff, where he is founder and editor of *Street Engineering* and editor of *World Construction,* recently took on additional duties following his promotion from editor-in-chief to editorial director of *Roads and Streets.* As a result of this change, Mr. McKeever's interests will now center around general aspects of the highway program, contractor interests, methods, and role in quality construction, plus eastern hemisphere civil engineering and construction.

Governor Stephen McNichols of Colorado met with the Consulting Engineers Association of Colorado recently to discuss greater use of consultants in the state highway program. The panel composed largely of ASCE members included (left to right) Clifford Johnson, Rhuel A. Andersen, the Governor, E. Vernon Konkel, Eugene B. Waggoner, and Alvin D. Swanson.

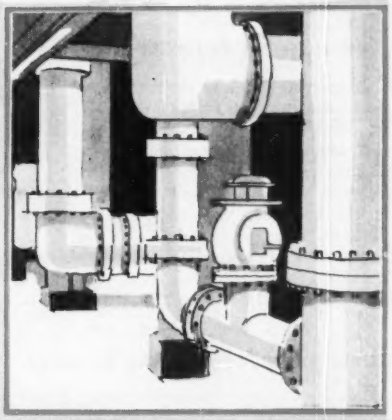
(Continued on page 18)

PIPE FACTS

In a recent survey, ten times as many contractors claimed more difficulty (breakage during installation) with composition pipe than with cast iron pipe.

DO YOU KNOW that where electrical thawing of mains and services is necessary, AMERICAN Fastite pipe can be installed with a specially designed and patented conductive gasket? This remains effective regardless of expansion, contraction or future movement of the joint.

DO YOU KNOW that the cost of replacing or repairing a broken pipe line can amount to many times the original cost of the pipe? Inconvenience to residents and merchants can also be costly. Initial pipe costs don't tell the whole story. Why gamble? Install time-tested cast iron pipe with "built-in" safety factors.



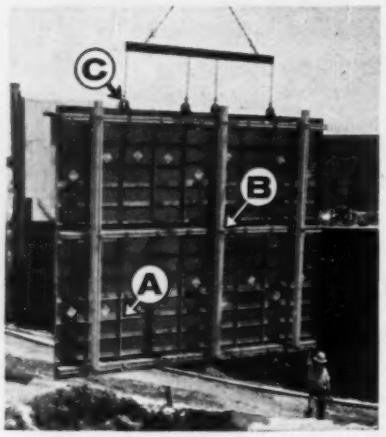
DO YOU KNOW that over a million pounds of AMERICAN pipe and fittings in the modern sewage treatment plant at South Bend, Indiana, helped this city to solve a serious river pollution problem? AMERICAN offers a complete line of piping to meet water, sewage treatment and industrial plant service.

DO YOU KNOW that every $4.50 invested in Otis Elevator stock in 1932 would now be worth approximately $89.00? Another sure long-term investment is dependable cast iron pipe. Utilities in 96 cities throughout the United States have cast iron pipe mains which have been in service for more than 100 years.

AMERICAN CAST IRON PIPE COMPANY
BIRMINGHAM ALABAMA

New Products

speed-up gang forming



New gang form bolt

Eliminates the necessity of stripping and resetting panels individually. Panels can be added or removed at any time. After gang section is set in place, ties are inserted. When stripping, ties can be broken back before removing section.

New gang form waler set

Attaching walers to gang sections is faster and easier. Simply insert waler rod between double waler, slip bracket over waler rod, and fasten securely with a wing nut. 6″ and 8″ rods are used with 2 x 4 and 2 x 6 walers...13½″ rods available for 2 x 4 or 2 x 6 walers with 2 x 6 strongbacks.

New gang form lifting bracket

Secure cable hooks to lifting brackets, and gang section is ready for stripping and setting. Safe recommended load per bracket is 2000 lbs. Approximate weight of square foot of section is 6 lbs (including hardware, walers and strongbacks.)

Write for more information about these new products.

D. A. Stromsoe, with the Southern Pipe Division of U.S. Industries, Inc., since its founding in 1932, retired recently as president. Over the years he has served progressively as engineer and assistant manager, vice president, executive vice president, president, and now will be retained by the division as a consultant.

Richard A. Widseth has been named to fill an interim appointment as city engineer and water department superintendent of Mason City, Iowa. Since graduating from the University of North Dakota in 1954, Mr. Widseth has worked as an engineer for the Minnesota Highway Department, a Minnesota consulting engineering firm, Wallace and Holland of Mason City, and for the past year with the Thorpe Well Company, of Des Moines, Iowa.

J. Gerald Ross, prominent civil engineer and civic leader of San Marino, Calif., recently joined the administrative staff of the Ralph M. Parsons Company, Los Angeles engineers-constructors. Formerly, project division manager of C. F. Braun & Company, he has also been a civil engineer with the U.S. Bureau of Reclamation, and commander in the Navy Civil Engineer Corps.

Michael A. Spronck, whose background includes experience in both the construction and editorial fields, in addition to continuing as editor of *Construction Equipment* (a Conover-Mast publication), a position he has held since 1958, will also serve the magazine as publisher. Mr. Spronck is a former assistant of the late D. B. Steinman, leading bridge designer; and former field editor of another construction publication.

Peter J. Reidy, commissioner of the New York City Department of Buildings, received the Award of the New York Association of Consulting Engineers at their annual dinner in October. Three years ago Mr. Reidy accepted the appointment as commissioner after many years as a leading New York structural engineer, who in addition to his work in New York designed numerous buildings throughout Canada, Cuba and Japan.

Clair C. Johnston, who previously taught at the University of Detroit from 1927 to 1942, has been named professor of civil engineering there. Before rejoining the University faculty recently, he was employed by the Square D. Company as a training director and by the Missile Division of Chrysler Corporation as supply manager and professional education director.

(Continued on page 23)

"We use ZEECON formulations in all our concrete"

■ "Not only in our ready mix but in our precast and prestressed," says General Manager John D. Smith of Ready-To-Pour Concrete Company, Idaho Falls, Idaho. By taking admixtures out of the "use only when specified" class and using them in all of their production, firms like Ready-To-Pour are not only producing better concrete but are saving money for themselves and their customers.

The ZEECON formulation used by Ready-To-Pour Concrete Company is EZ-W, supplied by Western Admixture Company, Logan, Utah.

"We've found that using EZ-W in all of our concrete helps us practice quality control methods that really pay off in lower costs and better concrete," says Mr. Smith. "For years we have tested each of our mixes regularly, breaking cylinders in our own lab. We've used the methods in ACI 214-57 to evaluate results, which we plot continuously and use to adjust mix design. EZ-W has smoothed out our strength plots at a higher level, with a significantly reduced coefficient of variation. We have designed mixes using this more uniform, stronger concrete to give our customers better quality, even when cement factors are reduced by as much as 12%. For example, in a recent 6-month period, our 6-sack plain mix averaged 4,440 psi with a coefficient of variation of 10.1% and our 5¼-sack mix with EZ-W averaged 4,920 psi with a coefficient of variation of 8.6%."

We urge you to look into the advantages of admixtures containing ZEECON dispersants. You will be surprised at the savings to be gained by daily use of this water reducing admixture.

John Smith, General Manager, (left) and Le Grand Marchant, Chief Engineer (right), Ready-To-Pour Concrete Company.

For additional ZEECON information, write to your nearest formulator or to Crown Zellerbach.

AquaREX
Concrete Chemicals Corporation,
725 Warrington Avenue,
Redwood City, California

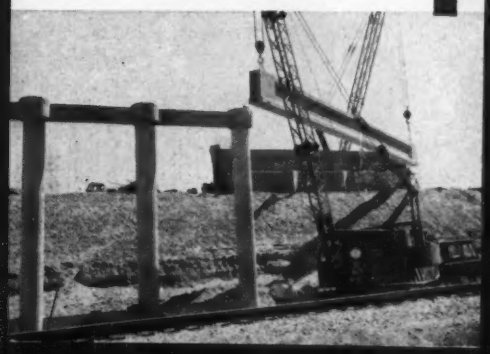
ChemCon
Florida Laboratories,
P.O. Box 672, Gainesville, Fla.

Econo-Mix
Super Concrete Emulsions, Ltd.,
1372 East 15th St., Los Angeles,
California

CONEX
Wescon Products, Ltd.,
3408 West 40th Avenue,
Vancouver, B. C.

EUCON
Euclid Chemical Company,
19218 Redwood Road,
Cleveland 10, Ohio

EZ-POUR
Western Admixture Company,
431 West 4th, Logan, Utah



CROWN ZELLERBACH
Chemical Products Division
Camas 43, Washington

*ZEECON is a trademark of Crown Zellerbach

a honey to handle

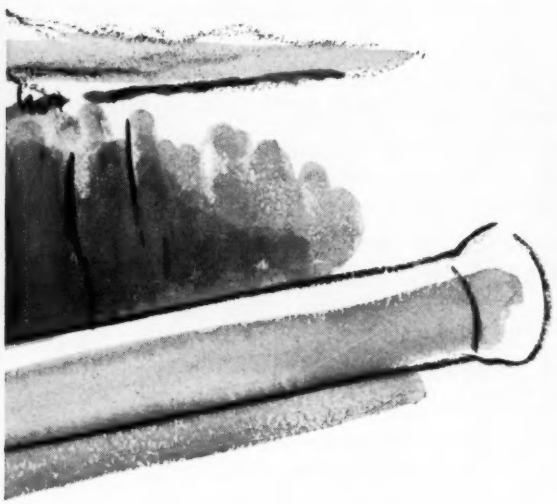
Tyton Joint® pipe, naturally . . .

This rugged dependable pipe goes together so easily even green crews become experts quickly. Consider:

Only one accessory needed—a rubber gasket. No nuts, bolts, bell holes, caulking equipment. And Tyton can be laid in rain or wet trench when necessary.

High installation costs crowding your budget? Get the time-and-money-saving facts on Tyton Joint* pipe today. Call or write:

*U. S. Patent No. 2,953,398 •



U. S. PIPE AND FOUNDRY COMPANY
General Office: Birmingham 2, Alabama

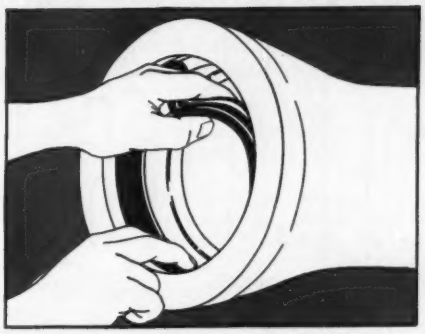
A Wholly Integrated Producer from Mines and Blast Furnaces to Finished Pipe.

Makers of USIFLEX® Boltless Flexible Joint Pipe.

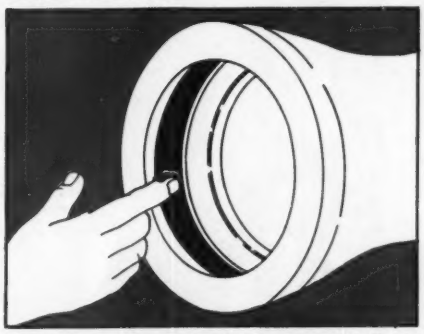
INDUSTRIAL SERVICE CAST® IRON

TYTON®

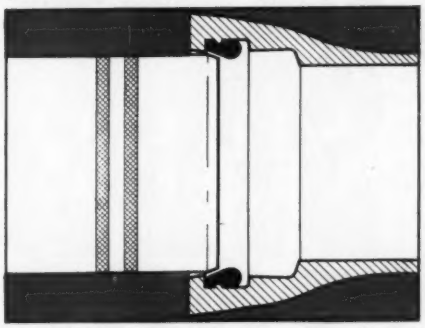
ONLY FOUR SIMPLE ACTIONS



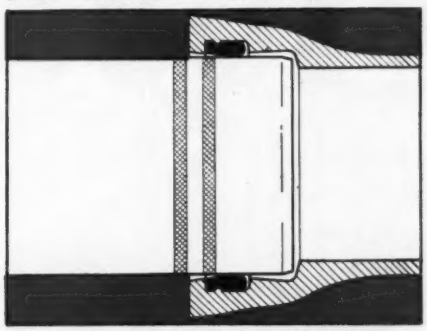
Insert gasket with groove over bead in gasket seat . . . a simple hand operation.



Wipe film of Tyton Joint® lubricant over inside of gasket. Your receiving pipe is ready.



Insert plain end of entering pipe until it touches gasket. Note two painted stripes on end.



Push entering pipe until the first painted stripe disappears and the second stripe is approximately flush with bell face. The joint is sealed . . . bottle-tight, permanently! The job's done . . . . fast, efficiently, economically. Could anything be simpler?

R. J. Lyman, chief engineer of Atlas Structural Concrete, Inc., of El Paso, Texas, will serve the Prestressed Concrete Institute as president for the coming year. Elected to serve as directors were **Albert L. Grubb,** chief of the Bureau of Bridges in the Maryland State Roads Commission; **George C. Hanson,** of Sallada & Hanson, of Denver, Colo.; and **Harold R. Hutchens,** general manager of the Carter-Waters Corporation's concrete products manufacturing facilities in Kansas City, Mo., who was re-elected as director.

George F. Flay, Jr., has been elected executive vice president of the Foundation Company, an engineering construction management firm in New York. For the past 25 years he has engaged in heavy construction work throughout the United States, Canada and Cuba.

W. A. Bugge, received his third national award this year in October as recipient of the Thomas H. MacDonald Memorial Award of the American Association of State Highway Officials in Denver, Colo. The director of highways for the State of Washington previously won the Charles S. Bartlett Award for outstanding contribution to highway progress and was named as one of the top ten public works officials of the nation by the American Public Works Association. The presentation was made by last year's winner, **Rex M. Whitton,** Federal highway administrator, and the only other man ever to have won all three honors.

Theodore W. Van Zelst, president and founder of Soiltest, Inc., one of the world's largest manufacturer's of engineering apparatus for research, education and laboratory testing of soils, concrete, asphalt and construction materials, has been elected a director of the parent company, the Cenco Instruments Corporation. Soiltest has been a Cenco subsidiary since 1959.

Charles D. Morrissey joined Praeger-Kavanagh-Waterbury in New York nine years ago, and now he has been admitted to the partnership. Recently he was associated with a number of defense projects designed by the firm; among them, the Forrestal carrier pier and other water front facilities for the Norfolk, Va., Naval District, and nuclear bomb-resistant, combat operation centers for the Air Force.

William G. Bieger as Allied Chemical's new paving materials representative for the Barrett Division will be responsible for the sale of bituminous concrete and liquid tars produced by its plants in the Dayton, Ohio area. He was recently civil engineer with Ayers & Grat in Cincinnati.

Richard Pian has been granted a leave of absence from Arizona State University where he is professor of engineering. For the next two years Dr. Pian will teach graduate courses in structures, as well as work with Thai students on their research activities and theses at the SEATO Graduate School of Engineering in Bangkok, Thailand.

Carlton C. Robinson, for the past six years a traffic engineer with the Automotive Safety Foundation, has been promoted to director of the Foundation's Traffic Engineering Division, succeeding **D. Grant Mickle,** who has been named deputy federal highway administrator. Mr. Mickle has directed the Foundation's traffic engineering program since its initiation in 1943; while Mr. Robinson, during 1958 and 1959, at the request of the District of Columbia Commissioners directed a study which led to a reorganization of the Capital's Department of Highways.

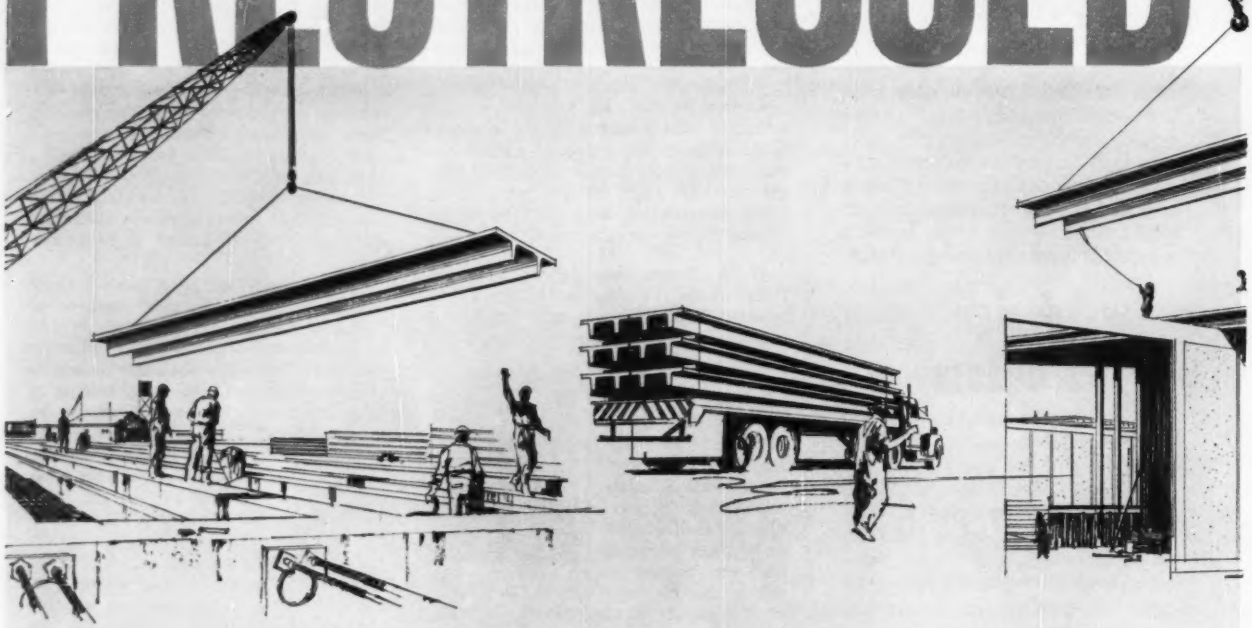
Carl E. Kindsvater is on leave for nine months from the Georgia Institute of Technology where he is Regents Professor in civil engineering to gather information at the University of California and its neighbor, Stanford University, leading to the organization of a water resources development program. The program will be discussed with faculty members of the California universities and one year from now will be instituted at Georgia Tech, preferably at the graduate level.

Frederick G. Lehman, a member of the Newark College of Engineering faculty since 1947, is now professor of civil engineering there. A specialist in the fields of numerical analysis and structural analysis and design, Professor Lehman at the beginning of this year was appointed director of the college's new computer center. From 1939 to 1942 he was an assistant professor at the Massachusetts Institute of Technology, and since 1942 has been with the Curtiss Wright Corporation, originally as a structural engineer and more recently as a consulting engineer.

Loren B. Almy whose specialty, reinforced concrete and structural designs, is of great importance to a developing country, for the next year will be adviser to India's Poona College of Engineering as part of AID's (the U.S. Agency for International Development, formerly the International Cooperation Administration) program to upgrade engineering education and develop technological institutions there. Professor Almy is on loan from Washington State University where he has been a member of the civil engineering faculty for several years.

(Continued on page 27)

PRESTRESSED



1 Prestressed concrete units are mass produced in the plant to exact specifications—while excavation and foundation work is taking place at the site. Close supervision and control of materials by a specialized work force in the plant produce a high quality product at minimum cost.

2 Plant production is not normally subject to delays due to adverse weather, as often happens to job site operations. Delivery is made as called for by contractors' work schedules.

For plant-produced, quality controlled prestressed concrete, consult the PCI Active Member nearest you:

ARIZONA Arizona Sand & Rock Co., Prestress Division, Phoenix • United Materials Inc., Phoenix

CALIFORNIA Basalt Rock Co., Napa • Bon C. Gerwick, Inc., San Francisco • Concrete Conduit Company, Div. American-Marietta Company, Colton • Delta Prestressed Concrete, Inc., Florin • Rockwin Prestressed Concrete, Santa Fe Springs • San Diego Prestressed Concrete, San Diego • Wailes Precast Concrete Corp., Sun Valley

COLORADO Bullen Concrete Products, Pueblo • Prestressed Concrete of Colorado, Denver • Rocky Mountain Prestress, Englewood

CONNECTICUT C. W. Blakeslee & Sons, New Haven

FLORIDA Capitol Prestress Co., Jacksonville • Concrete Structures, Inc., North Miami • Dura-Stress, Inc., Leesburg • Duval Engineering & Contracting Co., Jacksonville • Florida Prestressed Concrete Co., Inc., Tampa • Juno Prestressors, Inc., West Palm Beach • Lewis Manufacturing Co., Inc., Miami • Meekins-Bamman Precast Corp., Hallandale • Prestressed Concrete, Inc., Lakeland • Southern Prestressed Concrete, Pensacola • West Coast Shell Corp., Sarasota • R. H. Wright, Inc., Fort Lauderdale

GEORGIA American-Marietta Company, College Park • Leap Structural Concrete, Inc., Powder Springs • Macon Prestressed Concrete Co., Macon

HAWAII Concrete Engineering Co., Honolulu

IDAHO Gemstone Prestress Co., Idaho Falls • Ready-to-Pour Concrete Co., Idaho Falls

ILLINOIS American-Marietta Company, La Grange • American Prestcrete Corp., Plano • Consumers Div., Vulcan Materials Co., Chicago • Crest Concrete Systems, Lemont • Material Service, Chicago • Midwest Prestressed Concrete Co., Springfield • Precast Building Sections, Chicago • Prestressed Concrete Structures, Frankfort

INDIANA American-Marietta Company, Lafayette • Shute Concrete Products, Richmond

IOWA A & M Prestress, Clear Lake • Midwest Concrete Industries, West Des Moines • Prestressed Concrete of Iowa, Iowa Falls • C. W. Shiney Co., Waterloo

KANSAS Russell Ralph Co., Topeka • Sunflower Prestress, Inc., Salina • United Prestress Co., Wichita

LOUISIANA Belden Concrete Products, Inc., Metairie • Prestressed Concrete Products Co., Inc., Mandeville • Mid-State Prestressed Concrete, Inc., Alexandria

MARYLAND Baltimore Concrete Plank Corp., Baltimore

MASSACHUSETTS New England Concrete Pipe Corp., Newton Upper Falls • Northeast Concrete Products, Inc., Plainville • San-Vel Concrete Corp., Littleton

MICHIGAN American Prestressed Concrete Inc., Centerline • Lamar Pipe and Tile Company, Div. American-Marietta Company, Grand Rapids • Precast Industries, Inc., Kalamazoo • Price Brothers Co., Livonia • Superior Products Co., Detroit

MINNESOTA Cretex Companies, Elk River • Prestressed Concrete Inc., St. Paul • Wells Concrete Products Co., Wells

MISSISSIPPI F-S Prestress, Inc., Hattiesburg • Grenada Concrete Products Co., Grenada • Jackson Ready-Mix Corp., Jackson

MISSOURI Carter-Waters Corp., Kansas City • Dexter Ready-Mix Concrete Co., Dexter • Missouri Pres-Crete, Inc., Overland

Re-used Bethlehem steel sheet piling being driven at the new dock extension of Wilmington's Marine Terminal.

After 28 years' exposure to brackish water... this Bethlehem Steel Sheet Piling was USED AGAIN

In building an extension of a dock in the Wilmington, Del., Marine Terminal, the contractor pulled out 25,550 lineal feet of Bethlehem steel sheet piling. Driven in 1933, it was presumed to be ready for replacement. But after thorough examination, the piling was found to be in such excellent condition that it was decided to re-use all of it in building the new dock curtain wall. After 28 years' exposure to brackish water, the Bethlehem steel piling had lost little or none of its strength due to corrosion.

Bethlehem produces a full line of both sheet piling and H-piles. Our nearest sales office can give you our catalogs on piling and other details. Or write to us at Bethlehem, Pa.

Owners: Board of Harbor Commissioners, Wilmington, Del. Engineers: Modjeski & Masters; Contractor: Newark Construction Company. (Piling driven in 1933 by Thos. Earle & Son, Inc., Philadelphia.)

Steel

for Strength . . . Economy . . . Versatility

BETHLEHEM STEEL COMPANY, BETHLEHEM, PA.
Export Sales: Bethlehem Steel Export Corporation

BETHLEHEM STEEL

BETHLEHEM STEEL

W. J. Thompson, a captain in the Navy Civil Engineer Corps, recently reported for duty as public works officer of the Chesapeake area, with offices in Washington, D.C. Prior to this duty, Captain Thompson was executive assistant to the assistant chief for construction in the Bureau of Yards and Docks. In recent years he has also been civil engineer on the staff of the commander in chief, Atlantic Fleet; commanding officer of the Public Works Center at Guantanamo Bay, Cuba; and officer in charge of construction for the Far East, Bureau of Yards and Docks Contracts, Japan.

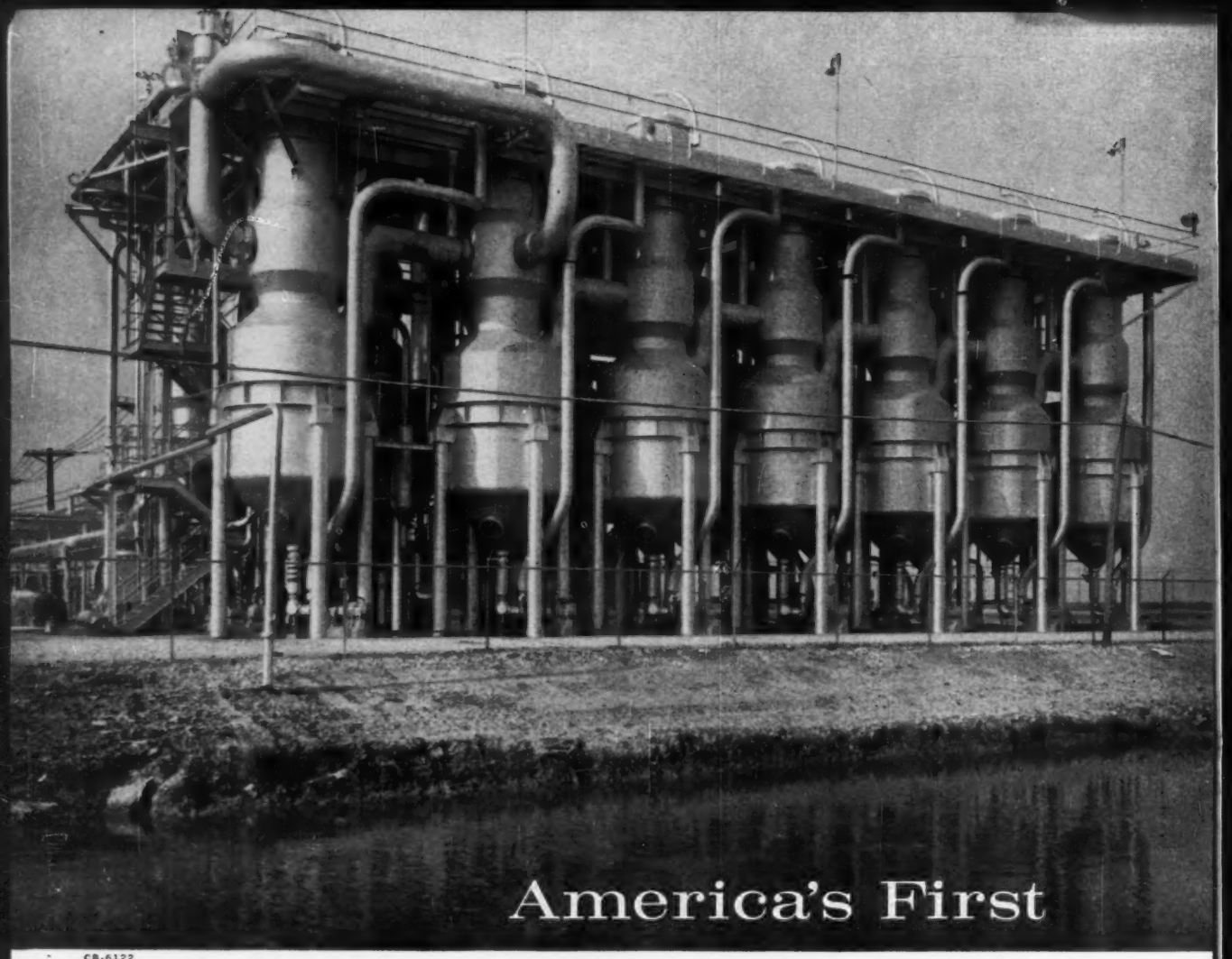
John C. Sprague is opening a consulting practice in concrete technology and will offer supplemental and auxiliary services in concrete and concreting materials. Until recently, he was associated with the Lock Joint Pipe Company as consulting concrete engineer, preceded by 30 years—from 1930 until his retirement in 1960—with the Army Corps of Engineers, where he served progressively as concrete engineer, director of the South Atlantic Division Laboratory, and as chief of construction materials investigation for the Middle and Far East.

John D. Winter, who joined Dames & Moore, of Los Angeles, Calif., in 1950, becoming an associate in 1960, has in 1961 become the fifteenth partner in the firm. During this period, he has worked in the firm's Seattle, Los Angeles, and Houston offices, serving as office engineer, field engineer, and staff assistant.

Leon Turner, new staff consulting engineer for the Los Angeles legal firm of Monteleone, McCrory & Skjeie, will provide contract administration and consulting engineering services to contractors and owners. He was formerly associated with the Los Angeles Department of Water and Power as contract claims engineer.

John Clayton Kohl whose activities and studies in the transportation field recently won him the University of Michigan's Distinguished Faculty Achievement Award, consisting of a certificate and $1,000, is now head of the newly created Office of Transportation within the Housing and Home Finance Agency's Office of the Administrator. To carry out the Washington assignment, he will be on leave until July 1, 1962 from the University, where for the past nine years he was director of the Transportation Institute and for six of those years was also professor of civil engineering. Professor Kohl is a founder member of the American Society of Traffic and Transportation.

(*Continued on page 106*)



America's First Experimental Seawater Conversion Plant

CB-6122

The steady decline of available fresh water may well find economical solution through this new experimental saline water conversion plant. It's America's first installation.

Built by CB&I for the Office of Saline Water, U. S. Dept. of Interior, it is capable of producing 1,000,000 gallons of fresh water daily from the salty Gulf of Mexico at Freeport, Texas. The facility is expected to produce this volume for less than $1 per thousand gallons.

Valuable operating information, including methods of combating corrosion and scale formation, will be provided for future and larger installations to follow.

CB&I completed the design, fabrication and erection of the steel structure in less than a year. This included an 8-day test run.

To learn how CB&I's extensive experience with process design, fabrication and erection in many fields can be advantageously applied to your plant problems, write to Chicago Bridge & Iron Company, 332 South Michigan Avenue, Chicago 4, Illinois. Offices and subsidiaries are located throughout the world.

CB&I **built it!**

. . . . . Am-Soc Briefs

▶▶ November 9 was Dedication Day for the United Engineering Center. . . . It was a festive day, with flags and flowers and distinguished guests, and a solemn day, with most speakers proclaiming the new Center a place dedicated to service to mankind through the arts of peace. . . . The story of the impressive ceremonies appears on page 48.

▶▶ It's Houston in February (19–23) and Omaha in May (14–18) for the next two ASCE Conventions. The Houston Convention discussed in this issue, will have the appropriate theme — "Planning and Building for Industrial Growth." . . . The Omaha Convention, initiating the new plan for ASCE technical programs, will be the First ASCE Water Resources Engineering Conference.

▶▶ Important deadline. . . . January 1 is the deadline for applying for the ASCE Research Fellowship — a $5,000 grant for full-time research established by the Society in 1958. The research contemplated should be basic rather than applied in nature and should not involve an extensive testing program. Members in any Society grade are eligible. . . . Details are given in the 1961 Official Register (page 160).

▶▶ Innovation. . . . For the first time the Society is able to offer scholarships to members of ASCE Student Chapters. Four annual awards of $1,000 — one for each of the Society's four Zones — will be available, beginning with the 1962–1963 academic year. March 1 is the deadline for applying. . . . Full details may be obtained from Student Chapter Faculty Advisers or from the item on page 51 of this issue.

▶▶ Are you enrolled in the Divisions of your choice? Members in all grades may enroll in two Technical Divisions (enrollment form on page 123 for the benefit of those not already enrolled), which will entitle them to receive all issues of the Journals of the two Divisions selected. There are fifteen of these Journals (including the Journal of Professional Practice), from which selection may be made. Members may also enter standing orders for additional Journals at $1.50 per issue, or for all Journals at $15.00 per year.

▶▶ Principles governing the professional practice of soil mechanics and foundation engineering are elucidated in this issue (page 72) by the ASCE Task Subcommittee on Professional Practice of Soils Engineering.

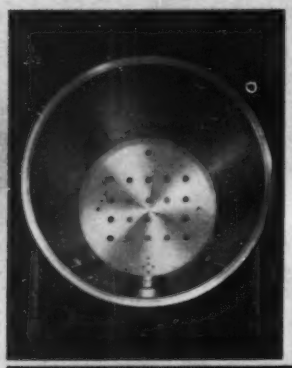
▶▶ What's ahead for civil engineering in 1962? The Technical Divisions have been asked to use their crystal balls. Their forecasts will make interesting reading in the January issue.

PDM STEEL COMPANY

PIONEER IN SPACE SIMULATION

a primary source for COMPLETE ENVIRONMENTAL FACILITIES

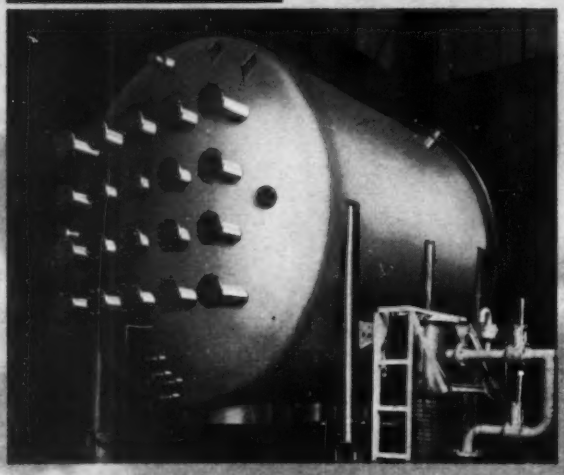
- High Vacuum Experience
- Field Erected Systems
- Cryo-Panels and Refrigeration
- Diffusion Pumping
- Stainless, Aluminum and Alloy Fabrication
- Solar Simulation
- Dynamic Model Supports

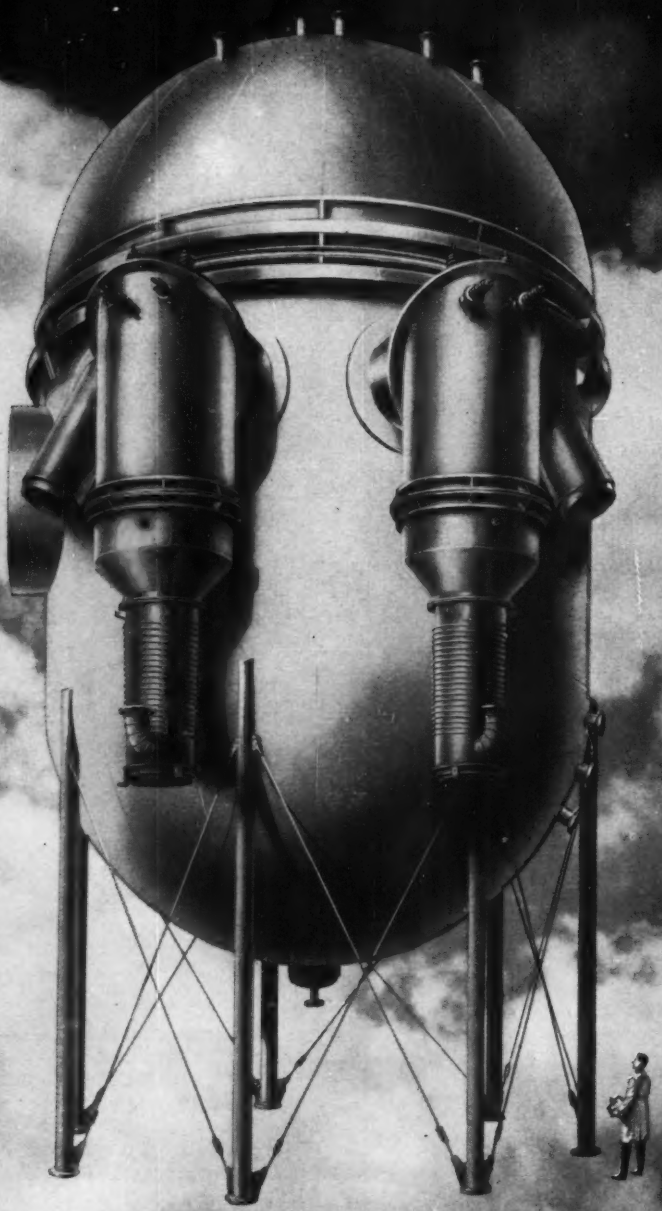


FOR CHANCE VOUGHT DALLAS

(Tenney Engineering, Inc.)

This polished chamber of stainless steel for Chance Vought's orbital simulation is 12 ft dia x 16 ft long. In service, pressure will be reduced to 1×10^{-7} mm Hg, or 1,100,000 ft. Lower photo shows mass spectrometer testing.





FOR GENERAL ELECTRIC VALLEY FORGE

The largest high vacuum chamber constructed to date —32 ft dia x 54 ft high. Designed for ultimate 10^{-9} service, this chamber has a polished stainless steel interior. Pump ports are equipped with PDM-designed liquid nitrogen cooled elbows. The vessel contract includes a pumping system designed and furnished by Consolidated Vacuum Corporation.

WRITE, PHONE, WIRE

PITTSBURGH-DES MOINES STEEL COMPANY

GENERAL OFFICES: Neville Island, Pittsburgh 25, Pennsylvania • FEderal 1-3000 • District Offices in Principal Cities

PLANTS AT: Pittsburgh, Warren, Bristol, Pa. • Baltimore • Birmingham • Des Moines • Provo, Utah • Casper, Wyo. • Santa Clara, Fresno, Stockton, Calif.

do you know that

The Russians are not building shelters? The prevailing attitude, voiced by both officials and the man in the street, seems to be one of fatalism—the conviction that there can be no defense against nuclear warfare. Mass circulation newspapers and magazines also ignore the civil defense problem. This report comes from the chief of the United Press International Moscow Bureau. The Swedish Government, on the other hand, has an effective long-range program of shelter construction, described in an article by Odd Albert, M. ASCE, in the November issue.

▪ ▪ ▪

The building industry will boom in 1962? American builders will have their best year in 1962, according to the F. W. Dodge Corporation's annual outlook statement just published in *Architectural Record*. The total spent on construction is expected to top $60 billion for the first time in history. This will be 7.1 percent better than the present good year. Increases in both residential and non-residential building and increased government spending for defense are expected to be dominant factors in the rise. Construction costs are expected to increase by about 3 percent in 1962.

▪ ▪ ▪

Steel output in October was the highest in 18 months? For the first time since April 1960 steel production in October crossed the 9-million-ton mark with an output of 9,170,000 tons. Production in the first ten months of the year, at 79,696,402 tons, was 9 percent below the 87,269,820 tons made in the comparable period of 1960.

▪ ▪ ▪

Deep-sea disposal sites for radioactive waste show no sign of increased radioactivity? The Atomic Energy Commission announces this encouraging finding after surveying its Pacific Ocean disposal sites, in 6,000-ft-deep areas (near the Farallon Islands and near Port Hueneme, Calif.), where some 25,000 "packages" of waste materials have been dumped since 1946.

▪ ▪ ▪

The U.S. is not running out of water? This is the contention of Kenneth MacKichan, F. ASCE, hydraulic engineer with the U.S. Geological Survey, in the October *Journal of the American Water Works Association*. He attributes popular concepts to the contrary to confusing the amount of water withdrawn with the amount actually consumed. Only water lost to evaporation or made unfit for reuse should be considered a measure of depletion, he says. Water actually consumed in the U.S. in 1960 totaled 61 billion gallons a day, whereas the amount available was over 300 bgd.

▪ ▪ ▪

Tacoma is moving sidewalk traffic by conveyor belt? The steep Washington city is using moving sidewalks to shuttle shoppers up and down the hillside of the central commercial district in the culmination of a project started two years ago. Two sets of rubberized mobile ramps have just been placed in operation, and two more will open soon. They can move 7,200 persons an hour at 90 fpm on an 11-degree grade.

▪ ▪ ▪

Motor-vehicle registrations are up this year? Registrations are expected to reach 76,007,000 by the end of 1961. This will be a gain of 2,106,000, or 2.8 percent, over 1960 registrations—a lower rate of increase than had been anticipated. Once again California leads with 8.1 million registrations, followed by New York with 5.1 million. Texas, Pennsylvania, and Ohio will each have over 4 million. The smallest registrations, as might be expected, will be in Alaska, Delaware, Nevada, and Vermont, with registrations of less than 200,000 each.

▪ ▪ ▪

An automated test highway is planned? Serious thought is being given to a plan to automate a 100-mile stretch of the Interstate System between two major cities in order to test electronic control of vehicles. One lane in each direction would be involved in the experiment, which would cost about $50 million.

▪ ▪ ▪

Highway construction costs continue to edge downward? The slight drop (1.1 percent) in the third quarter of 1961 continues a trend that started in the fourth quarter of 1960, according to the Bureau of Public Roads. Most of the drop was credited to slightly lower prices in reinforcing and structural steel and structural concrete.

▪ ▪ ▪

Engineers at the top have voted "Civil Engineering" the most regularly read of technical magazines? The survey, made for *Time* magazine, included a random sampling of 1,000 engineers listed in the current issue of *Who's Who in Engineering*. The same representative engineering group voted *Time* "the most important magazine published in the U.S. today."

As any good mason knows, first-class masonry performance demands the finest possible combination of workmanship and materials. That's why more masons are choosing Lone Star Masonry Cement. It combines all the necessary ingredients, except sand and water, in exactly the right proportions. You get all the properties of top-quality mortar plus complete uniformity from sack to sack. That's not all! Lone Star Masonry Cement saves time, trouble and money... cuts your mixing time, makes clean-up easier, lets you get more production without unnecessary hustle. For the finest quality mortar at the lowest possible cost, specify Lone Star Masonry Cement. Try it on your next job. Lone Star Cement Corporation, 100 Park Avenue, New York 17, N.Y.

LONE STAR MASONRY CEMENT

World's largest drydock

T. N. TATE, A.M. ASCE
Lt., CEC, USN; Assistant Resident Officer-in-Charge of Construction
Bureau of Yards and Docks Contracts, Bremerton Area, Bremerton, Wash.

The world's largest drydock, at the Puget Sound Naval Shipyard, Bremerton, Wash., is being built partly on undisturbed material and partly on fill, consolidated by Vibroflotation. This reinforced-concrete dock is 1,180 ft long from head end to outboard face, and 180 ft wide from coping to coping. It is 61 ft deep, with 53 ft of water over the sill at mean high water, and will accommodate the Navy's largest ships.

This is a relieving-type dock, that is, it depends on the relief of hydrostatic pressure beneath it for stability as opposed to a gravity-type dock, in which sheer weight resists the uplift pressure on the empty structure. This drydock was designed by Moran, Proctor, Meuser and Rutledge of New York, N. Y., and Carey and Kramer of Seattle, Wash., for the Bureau of Yards and Docks, U. S. Navy.

When completed in March 1962, the drydock will permit overhaul and repair of supercarriers (which cannot traverse the Panama Canal) in the area of their assignment. The supercarrier *Ranger* already is operating in the Pacific. It will soon be joined by the *Kittyhawk* and the *Constellation*.

The big drydock is roughly rectangular in shape with vertical walls supported on the floor slab. A partitioned box structure at the top of the wall, which extends the full length of the dock, serves as a tunnel for the electrical and mechanical services. The dock floor-slab is relatively thin, that is, 7 ft thick, with edges thickened to 12 ft under the walls. The side walls vary in thickness from 12 ft at the floor line to 2 ft 9 in. just below the utility tunnels. The utility spaces are supported on the top of the dock wall and on precast concrete columns 22 in. square, spaced 16 ft on centers. The utility tunnel walls serve as supporting structures for the inner crane tracks. A floating caisson will be used for closure of the drydock. The dock is served by

Bremerton supercarrier drydock in October 1960, when the work was about half completed.

Fill material was washed from scows by hydraulic jet.

three electric substations and a 5,000-cfm compressor plant, as well as steam, fresh-water, salt-water, power, telephone and sewage lines.

Hydrostatic relief

Hydrostatic relief of the drydock is accomplished by continuous removal of water from a granular drainage course beneath the dock floor and outside the dock walls and from granular backfill around the walls. Sheetpile cutoff walls help to minimize inflow. The principal features of the drainage system can be seen in Fig. 1. Under the floor there is a well-graded granular drainage course in which is embedded a grid system of perforated drainage pipe terminating in drainage tunnels running the full length of the dock. A similar system of drainage pipe is placed in the base of a triangular section of drain-course material outside the dock walls. This pipe also terminates in the drainage tunnels. From the drainage tunnels, infiltrating water flows by gravity to the drydock pump well, where automatic drainage pumps move it overboard. A gravity dock—in which a sufficient mass of concrete would provide the necessary weight to resist uplift—would require a floor slab about 43 ft thick.

Contract specifications delineated a specific construction sequence. The entire work was divided into four major construction phases. First, the surface layer of soft green organic clay was removed by dredge and replaced by imported select backfill. The dredging depth varied from 2 to 40 ft.

Next, steel sheetpile bulkheads were installed on each side of the construction site, and eleven circular sheetpile cells, each 60 ft in diameter, were installed and filled to close the outboard end.

The third phase consisted of dewatering the site, trimming the side slopes, making the necessary site excavation in the dry, and constructing two additional cofferdams at the head end and at pumpwell locations.

The actual construction of the dock—filling between the dock walls and the construction dams, construction of miscellaneous supporting features and clean-up, including the removal of the entrance cofferdam—can be called phase four.

In December 1958, the construction contract was awarded to the joint venture of Manson-Jones-Perini-Osberg for the lump sum of $21,645,000. Work commenced in January 1959 and is now 90 percent complete.

Of the 600,000 cu yd of unsuitable material removed, two-thirds was taken by suction dredge. It was pumped to a disposal area 7,000 ft from the site in a deep part of the adjacent Sinclair Inlet. The remaining one-third was picked up by a barge-mounted derrick and clamshell.

From the borrow pit, some 3 miles from the construction site, came 1,300,000 cu yd of select fill and backfill. The material was reasonably well graded to a 3-in. maximum size with no more than 10 percent passing the 100-mesh screen. Transported to the site by barge, the material was offloaded and placed by sluicing off the sides, using tug-mounted hydraulic monitors.

About 3,000 tons of 27-psf, Z-section piling was driven in a single line and supported in berms along the full length of the dock. The sheets varied in length from 60 to 110 ft and were driven 10 ft into the undisturbed natural material. The cellular cofferdam required 2,400 tons of 28-psf, flat-section piling. The eleven cells at the dock entrance were filled with the same material used for fill and backfill. When the cells are removed, this material will be re-used as fill in the mole areas. On March 8, 1960, the cofferdam was closed and dewatering commenced.

Dewatering system

The contract required that the contractor furnish, install, maintain and remove a temporary dewatering system as required to lower and control ground-water levels so that the drydock, pumpwell, discharge and intake structures and other structures in the mole areas might be constructed in the dry within the sheetpile enclosure. The design of the dewatering system was subject to the approval of the Officer in Charge of Construction, but this approval did not relieve the contractor of the responsibility for providing an adequate dewatering system. Definite ground-water levels were specified during various stages of construction.

During the lowering of the open water inside the construction area, it was required that the dewatering should proceed in such a manner that the ground water was not more than 4 ft above the open water at any time. At no time was seepage or piping permitted on the interior slopes of the

Draglines, trucks and conveyors completed excavation and leveled the bottom.

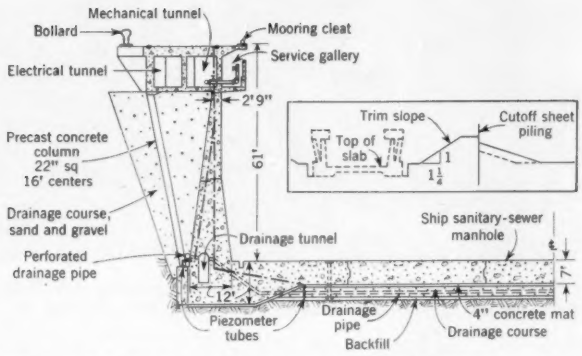


FIG. 1. Half section through the Bremerton drydock. Drainage to relieve hydrostatic pressure permits use of thin walls and floor.

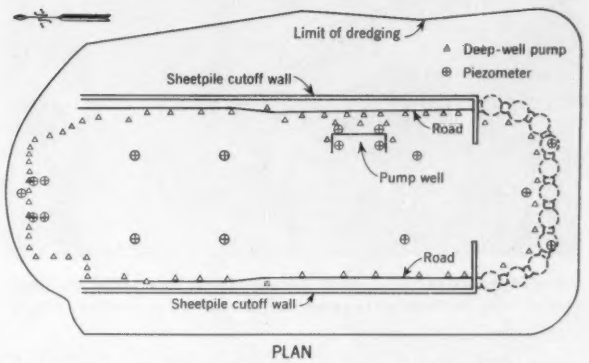


FIG. 2. Circular sheetpile cells close the outer end of the drydock and lines of Z-sheetpiles aid in cutting off infiltration of water.

construction dams, as these might endanger the stability of the slopes. Following the drawdown of the open water, and during construction in the dry within the sheetpile enclosure, the ground-water level was required to be maintained at least 2 ft below the subgrade of the excavation.

The contract required that an emergency refilling system be provided of a size to permit flooding of the construction site to a balanced water level in a period not to exceed 12 hours. It was the responsibility of the contractor to determine whether flooding was necessary, and to prevent damage to the cofferdam or structures. Fortunately flooding was not needed.

To meet these requirements, the contractor's dewatering subcontractor, American Dewatering Company, developed a three-part dewatering system. To remove the 175 million gal of free water, 12-in. centrifugal skid-mounted pumps were used.

Along the perimeter of the construction site were placed 66 electric submersible deep-well pumps, varying from 3 to 20 hp. These were needed to remove the entrapped water in the berms, to remove an expected 20,000 to 30,000 gpm of infiltrating water, and to lower the water table 60 ft. To provide a constant check on the water level under the site, 18 temporary piezometers were placed, as indicated on Fig. 2.

Well-point system installed

On completion of the slope trimming, a 400-point wellpoint system was installed. The headers and points were placed just outside the location of the dock structure, at the toe of the trimmed slope. Note that no intermediate ring of wellpoints was placed. The use of deeply placed submersibles to function as a primary interceptor, and to remove the berm pore-water, eliminated the need for an intermediate ring. In addition, this arrangement facilitated slope trimming and accelerated construction. In Fig. 3 it can be seen that both the submersible and the wellpoint tips lay in the stratum of very compact, gray, gravelly, fine-to-coarse sand, which was the best aquifer under the site.

Infiltration was much less than expected. About 10,000 gpm was removed during initial dewatering stages; this soon stabilized after the addition of wellpoints to a steady rate of 7,000 to 8,000 gpm. Sections of the wellpoint system were removed as permenant construction was completed. The deep-well system was maintained until the cofferdam was flooded upon completion of the construction of the drydock.

Some 380,000 cu yd of material was removed from the dewatered basin when the slopes were trimmed. The slope of the berm fill was cut back from 1 vertical on 2¾ horizontal to 1 vertical on 1¾ horizontal. Excavation to grade, construction of work roads and access ramps were also carried out.

About half the material was removed by dragline and truck, the rest by a conveyor, which cast the material over the side of the cofferdam to a stockpile. This material was to be reused to backfill between the completed dock wall and the construction berm.

When excavation was completed, a 12-in. lift of dry-placed material was spread and the contractor commenced compaction by the use of a 50-ton, rubber-tired, tractor-driven compactor. Consolidation under the compactor was significant. In some areas a waving of the fill was noticed; the material seemed to be compressed under load and then to rebound when the load was removed. The top foot showed good compaction, but the whole area seemed to be "floating." Additional borings showed that practically all the river silt had been removed; however, the material in place was finer in all screen sizes than permitted by the specifications. The compaction of the soil and its bearing capacity, as judged by the low blow counts on the sampler (two or three blows for 6 in. of penetration in some cases), were far too low to be acceptable.

Vibroflotation to strengthen foundation

Various methods were considered for strengthening the foundation soil, such as settling it by explosives or by the driving of piles. The former was rejected because of possible damage to the cofferdam. The latter was not considered economical or practical. The architect-engineer proposed Vibroflotation as a practical solution to the problem.

This process is relatively new; it was introduced into the United States some

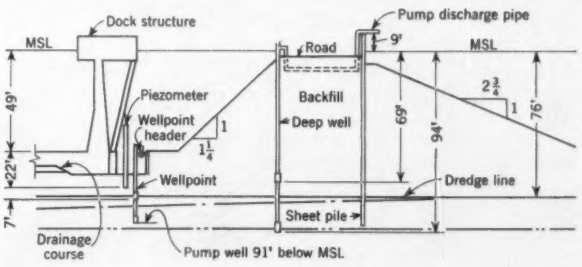
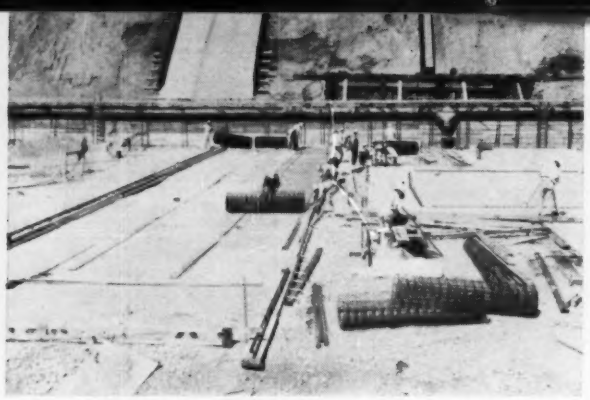


FIG. 3. Typical section through dewatering installation for drydock. Note location of piezometers and pumps in Fig. 2.

Vibroflot is seen in action. About 6 cu ft of sand was added per linear foot of hole. As material is compacted, the Vibroflot is raised.



Wire mesh was used to reinforce a 4-in. concrete working slab. Note wellpoints and flume that is part of installation for quick flooding.

15 years ago. It employs mechanical vibration and simultaneous saturation with water in combination with the addition of material to move, float and compact the soil into a dense state. The device used is called a Vibroflot. Operation of the Vibroflot (Fig. 4) requires two stages of water discharge—one lower jet to assist in inserting the Vibroflot, and side jets to place the material to be compacted in a "quick" condition. About 60 to 80 gpm at 80 psi is required.

Vibratory energy is supplied by a 30-hp, 440-v a-c, water-cooled, electric motor driving a 200-lb eccentric, 1¼ in. off center, at a speed of 1,800 rpm. A centrifugal force of 10 tons is developed. Maximum movement of the bottom of the Vibroflot is ¾ in.

In use the vibrating tool is jetted to the desired depth under its own weight. The bottom jet is shut off and water forced out and up through side jets. Additional material is added by hand labor from the surface, in the void created by the jetting and vibration. As the material is compacted, the Vibroflot is raised—one foot at a time. Control is accomplished by an ammeter in the crane operator's cabin, which indicates the current required by the vibrator's drive motor. When the ammeter reaches the desired peak reading, the Vibroflot is raised. The jetting and compaction time is variable, depending on the material and the depth.

The primary program contemplated that compaction would be carried out in two longitudinal strips parallel to, and inboard of, the edges of the dock walls, and in a transverse strip across the full width of the entrance. The amount of material that must be added during compaction is called the "take," which is directly related to the difference in density of the base material before and after compaction. The amount of take required for each Vibroflot hole in the initial program was relatively high, indicating low initial density.

The Officer in Charge of Construction determined that it would be advisable to expand the program to include all areas of the drydock foundation where the fill was more than 8 ft thick. The final program therefore included a total plan area of 68,000 sq ft; 848 Vibroflot holes spaced about 10 ft on centers were placed to an average depth of 11.15 ft. On the average, slightly more than 6 cu ft of additional material per linear foot of hole was added in the compaction. More than 2,000 cu yd of sand and gravel was added but the surface actually was left lower.

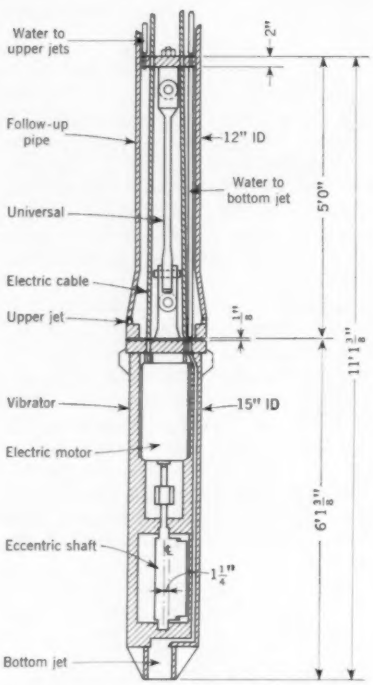


FIG. 4. Section through Vibroflot. Water under pressure is discharged through bottom jet to assist penetration, then through side jets as machine is withdrawn.

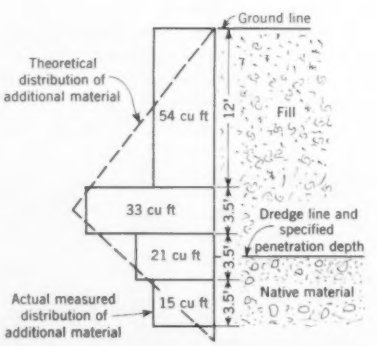


FIG. 5. Distribution of added material around a Vibroflotation compaction test point shows that about 50 percent of the added material was in the bottom 30 percent of the hole.

Settlement observations made on hubs at the ground surface before and after compaction indicated that the surface of the ground settled about 1/10 ft, on the average, between compaction points. The measurement of take for holes varying in depth confirmed the field measurements of take for the entire program (Fig. 5), and revealed that:

1. The take per foot increased with increased hole depth until the hole penetrated native material; it then decreased.

2. About 50 percent of the added material was placed in the bottom 30 percent of the hole.

Vibroflotation compaction at null points (the center of four holes 10 ft apart) showed a take about 30 percent that of the average for the regular holes.

The addition of 0.075 cu ft of material for every cubic foot of total material treated, plus a settlement of 0.1 ft, would mean a densification equivalent to adding 7 to 8 lb of material to every cubic foot of material treated. If the following values are assumed to be an average of the hydraulically placed fill under the dock floors:

Dry unit weight before treatment	115 pcf
Minimum dry unit weight	100 pcf
Maximum dry unit weight	130 pcf
Est. relative density before treatment	50 percent

then the addition of 7 to 8 lb of material would mean an increase in the estimated relative density from 50 per-

Rail-mounted traveling gantries moved and held forms for the drydock wall. They also served as scaffolding for steel and concrete placement.

Temporary timbers held the columns that help support the pipe galleries. Note the several types of compactors working on the fill.

cent to about 75 percent. To achieve the same effect through consolidation, the drydock, if supported by this material, would have had to settle an average of 9 in.

Results evaluated

From the results of the tests and control measurements, it was concluded that the Vibroflotation compaction influenced the area midway between the Vibroflotation holes, and achieved the greatest compaction where it was most needed—in the deeper, finer-grained fill material. The relative density achieved at null points was estimated as between 60 and 65 percent. The relative density at the hole itself was estimated at between 85 and 90 percent.

On completion of compaction and finish grading, 2 ft 8 in. of select gravel, drainage-course material, was placed and compacted to 100-percent optimum moisture density. A grid system of vitrified clay pipe was installed and a polyethylene protective sheet placed over the drainage course. A concrete working mat 4 in. thick, reinforced by wire fabric 6 x 6 x 6, was placed to protect the drainage system from damage and provide a working surface.

The 85,000 cu yd of concrete in the floor (7 to 12 ft thick) was placed in about 250 monoliths, each 24 x 40 ft.

Steel panel forms were used for the foundation blocks and for the walls as well. Rail-mounted travelers provided for the moving and support of the wall forms during concreting. They also served as scaffolding for steel and concrete placement. Two gantries were required: one for the low wall blocks, 24 ft high, and one for the upper blocks, the tops of which were 48 ft above the dock floor. Concrete was batched in a semi-automatic plant located 0.2 of a mile from the dock site; it was transported in 2- and 4-cu yd buckets by truck.

When the walls were finished, the concrete columns were placed and held by temporary restraints. Perforated tile was laid at the base of the wall, and backfilling between the dock wall and the construction berm was commenced. Fill was placed in 1-ft lifts and compacted to 100-percent optimum moisture density by vibratory compactors of surface type.

Forms were then placed for the walls and roof of the service tunnels and gallery using steel panels. A traveling gantry for moving and holding the forms in place accelerated this work.

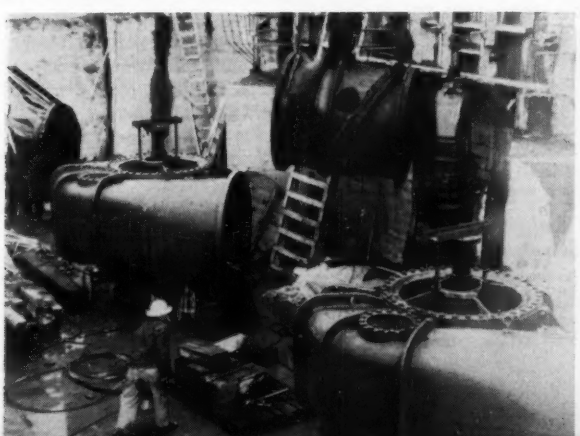
Pumpwell features

Incorporated in the dock structure is a reinforced concrete pumpwell 65 x 139 x 90 ft deep, which houses the "vital organs" of the drydock. A wet well of ¼-million-gal capacity, a substation, control consoles for dock flooding and dewatering, drainage-relief pumps and motors, and the main dewatering pumps and motors, are contained in the pumpwell. Three 15,000-gpm drainage pumps are available for the drainage-relief system. The four main pumps, of 115,000 gpm each, can remove 88 million gal of water from the dock chamber in about four hours.

Flooding is accomplished by gravity through a short culvert incorporated in each of the dock sidewalls. The culverts extend from the entrance abutments inboard a distance of 80 ft, terminating in a transverse culvert just inboard of the inner caisson seat. Eighteen flooding slots are provided directly over the transverse culvert. These slots are arranged in a line parallel to and just inboard of the inner caisson seat. Some 88 million gal of water will be admitted in a 90-min filling period.

Manson-Jones-Perini-Osberg has expended some 1,500,000 man-hours of effort in 33 months of construction. The dock work area was allowed to fill with water early in October and the entrance cofferdam is now being removed. Work is progressing rapidly in order to meet the contract completion date, March 27, 1962.

Four 115,000-gpm pumps installed in the drydock can remove 88 million gal of water to empty the chamber in four hours.



The drydock in October 1961, just before flooding and removal of construction cofferdam. Contract completion date is March 27, 1962.

"No water resources program is of greater long-range importance than our efforts to find an effective and economical way to convert water from our oceans into water fit for consumption in the home and by industry."
—*John F. Kennedy*

Where we stand on saline water conversion

FRANK SCHNELLER, A.M. ASCE
Associate Editor
Civil Engineering, New York, N. Y.

Water delivered to the consumer at a cost of $1.45 per thousand gal will not seem like much of a bargain to most American engineers. In nearly all areas of the United States, water is available for about 25 to 40 cents per thousand gal. But to the people of Coalinga, Calif., $1.45 is just about 15 percent of what they formerly had to pay. Coalinga, in the San Joaquin Valley, midway between San Francisco and Los Angeles, previously hauled its water some 45 miles from Armona, Calif., by tank car at a cost of about $7.00 per thousand gal. Delivered to the customer, the cost rose to over $9.00.

In 1959, Ionics Incorporated built the nation's first municipal desalinization plant for the city of Coalinga. This electrodialysis plant has been continuously treating brackish well water since that time. With a capacity of 28,000 gpd, the plant is reducing salt content from about 2,000 to 300 ppm (parts per million).

The Coalinga plant provides fresh water to the second branch of a dual piping system for domestic purposes. It has been estimated (by Ionics) that if the plant had been built with a capacity of 2 mgd, the cost of the water produced would go down to about 40 cents per thousand gal.

Along with Coalinga, the rest of the world is showing keen interest in saline-water conversion. Our present water supply is not unlimited. Over 300 billion gal of water is used every day in the United States. On a per capita basis this amounts to about 1,700 gpd for every American. Domestic use averages less than 150 gpd per person but industrial processes take prodigious quantities.

The average daily stream flow in the United States amounts to some 1,100 billion gal daily (bgd) but only about half of that can be considered as a dependable usable supply. Even though much of this water is reused, new sources will be needed.

Estimates call for anywhere from 500 to 600 bgd as the basic requirement—only 20 years from now. And between 900 and 1,000 bgd are expected to be needed by the year 2000. In view of this tremendous future increase in water use, the government has cooperated with universities and with industry in studying the possibilities of securing economical water through saline conversion.

The Saline Water Act

In 1952 Congress passed the Saline Water Act (Public Law 448, 82nd Congress) providing $2 million for a 5-year study of economical means of developing fresh water from saline water. Research and development were entrusted to the Office of Saline Water (OSW), Department of the Interior, which farmed out research and development contracts to institutions and industries. This act was amended in 1955 by Public Law 111 (84th Congress), which increased the appropriation to $10 million and extended the time to 10 years. Under these acts the Federal Government has worked jointly with state and local governments, private industry, and educational institutions in establishing pilot plants to study the various processes of saline-water conversion.

A law (Public Law 883, 85th Congress) passed in 1958 added substantially to the already mushrooming developments. An additional $10 million was authorized to "provide for the construction, operation, and maintenance of not less than five demonstration plants for the production from sea water or brackish water of water suitable for agriculture, industrial, municipal and other beneficial consumptive uses."

One of the last things the 87th Congress did before adjourning late last summer was to pass Public Law 87-295, which authorizes an additional $75,000,000 for further study (research and development) of saline-water conversion between 1963 and 1967.

Five demonstration plants

The 1958 law called for three plants for the conversion of sea water—two with capacities of at least 1 mgd. Sea water is defined as water having approximately 35,000 ppm of dissolved salts. The other two plants are to be for brackish water—that having from 1,000 to 35,000 ppm of dissolved salts—one of them to have a capacity of at least 250,000 gpd and the other, 1,000,000 gpd. The law requires that the five plants represent five different processes; it also places certain limitations on their geographic locations. Table I shows the conversion processes considered for the demonstration plants. Drinking water, as recommended by the Public Health Service,

TABLE I. Conversion processes to be considered for demonstration plants

1. Multiple-effect evaporation
   - Submerged tube
   - Long-tube vertical
2. Flash exaporation
   - Single-effect temperature differference
   - Multistage
3. Electrodialysis
   - Tortuous-path flow
   - Sheet flow
4. Freezing
   - Indirect
   - Direct
5. Vapor compression
   - Rotary
   - Tubular
6. Critical pressure
7. Solar distillation
8. Solvent extraction
9. Osmionics
10. Reverse osmosis
11. Ion-exchange
12. Combinations of the above, or others

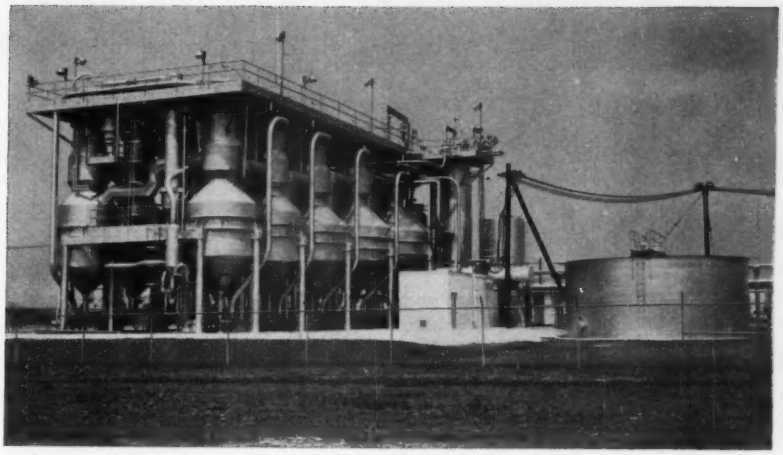
should have less than 500 ppm of dissolved salts.

Producing fresh water from saline water by evaporation is certainly not a new idea. It has been used for years aboard ships, both for drinking water and to supply the boilers. There is also more than 20 mgd of fresh water presently produced from land based saline water plants throughout the world. These plants are located at places where a supply of fresh water is imperative despite high costs or other difficulties.

The largest sea-water distillation plant in operation today is on the Island of Aruba in the Dutch West Indies, off the coast of Venezuela. This $10 million, multiple-effect distillation plant produces nearly 3 mgd for about $1.75 per 1,000 gal delivered to the consumer. The largest complex of conversion equipment is found in Kuwait (on the Persian Gulf) with a daily production of 7.5 million gal.

It is probable that no one single process will ever be developed that will be superior to all others for all types of water at all locations. Each process has advantages for particular applications. Factors to be considered include whether the water to be treated is sea water or brackish water and the quantity of dissolved salts present in it. Whether the installation is for a private home or a municipal supply is also of extreme importance in the choice of processes. Also to be considered is the location of the proposed plant. Factors connected with the location, such as fuel costs, weather conditions, and waste-disposal conditions, are vital in determining which of several processes would be most advantageous in a given case. However, the distillation process is currently the most widely used and probably it is the most important method for large-scale sea-water conversion on land or sea.

Five processes have been selected for the first demonstration plants:



At Freeport, Tex., the first of five demonstration plants—set up by the Office of Saline Water of the Department of the Interior—converts a million gallons of sea water into fresh water daily. This plant, of the multiple-effect, long-tube, vertical-distillation type, provides fresh water for about $1.24 per thousand gal.

multiple-effect long-tube vertical distillation for sea-water conversion; multi-stage flash distillation for sea-water conversion; an electrodialytic process for brackish water; forced circulation, vapor-compression distillation for brackish water; and a freezing process for sea-water conversion. Table II gives pertinent data for each of these plants and processes.

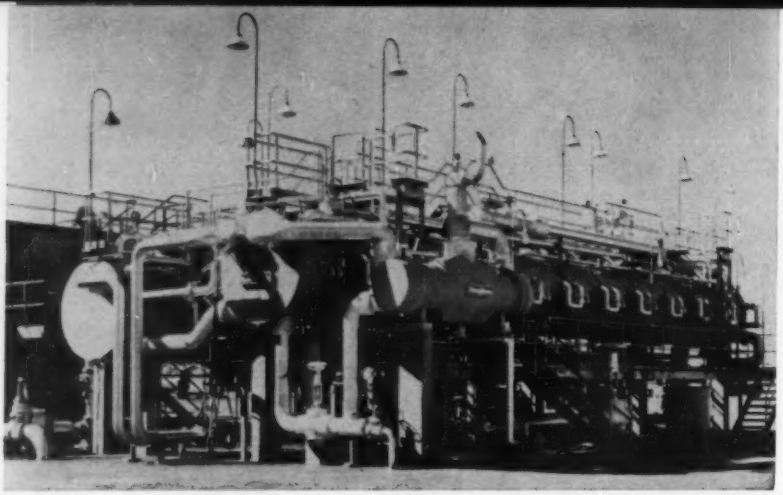
A long-tube vertical distillation plant

Last June the first of the five plants went into operation at Freeport, Tex. This multiple-effect long-tube vertical distillation plant has a design capacity of 1 mgd. Here saline water is passed through long vertical tubes in which it is raised to boiling temperatures by condensing water vapor or steam on the outside of the tubes. The feed proceeds to a separation chamber where the clean vapor is separated from the brine.

In a multi-effect plant, such as the one at Freeport, the outgoing fresh water preheats the incoming sea water, which then enters the first effect, where it is boiled by steam heat. The water vapor produced here goes to the shell side of the second effect, where it is maintained at lower pressure than the first. Here it condenses and yields heat to boil the feed, which

TABLE II. Plants in demonstration program for saline-water conversion

Location	Process	Capacity, gpd.	End Product, dissolved Salts in ppm	Architect and Engineering Contract	Construction Contract	Remarks
Freeport, Tex.	Multiple-effect long-tube vertical type distillation	1,000,000, sea water	15-20	Sept. 24, 1960 W.L. Badger & Assocs. $112,000	June 8, 1960 Chicago Bridge & Iron $1,252,797	On line June 1961
Point Loma, San Diego, Calif.	multi-stage flash evaporation	1,000,000, sea water	15-25	Sept. 24, 1960 Fluor Corp. $102,000	Nov. 5, 1960 Westinghouse Elec. Corp. $1,608,000	On line Jan. 1962
Webster, S. Dak.	Electrodialysis	250,000, brackish well-water, 1,800 ppm	250	Sept. 24, 1960 Bur. of Reclamation $50,000	Nov. 16, 1960 Asahi Chemical Co., Ltd., and The Austin Co. $482,000	On line Oct. 1961
Roswell, N. Mex.	Forced circulation vapor-compression	1,000,000, brackish well-water, 24,000 ppm	50	Oct. 28, 1960 Catalytic Const. Co. $96,700	Bid Opening, Dec. 5, 1961	On line Jan. 1963
Wrightsville Beach, N. C.	Freezing	250,000, sea water	less than 400	Lummus Corp. $99,800	.....	On line May 1963



This multi-stage, long-tube, flash evaporator, rated at 10,000 gpd and located at Southern California Edison's Mandalay Steam Station, utilizes waste steam from the generating plant. Significantly, it represents a step sponsored entirely by private industry to bring economic conversion of sea water closer to reality. Photo courtesy of Cleaver-Brooks, who designed, engineered and manufactured the unit.

is liquid carried over from the first effect. See Fig. 1. The condensed vapor is the desired fresh-water product. The cycle is repeated through all following effects at progressively lower temperatures and pressures.

A pilot distillation plant operating as described above was built at the International Nickel Company's Marine Corrosion Test Station at Harbor Island, N. C. This plant was designed and operated to develop an economical cycle based on the use of long-tube vertical evaporators.

To apply the knowledge gained from the pilot plant to practical use, the OSW built its first demonstration plant with 12 effects, using long-tube vertical evaporators. The first-effect temperature is 250 deg F and the final-effect temperature 110 deg F. The final brine is concentrated about four-fold.

Scaling on equipment surfaces exposed to saline water is one of the main problems to be overcome in converting saline water to fresh. One method of preventing scaling, employed at Freeport, uses fine crystals (seeds) of the scale-forming material in suspension. When these are introduced into the evaporating liquor, additional scale forms on the seeds rather than on heating surfaces.

Half of the product water of this plant is being sold ($0.30 per 1,000 gal) to the Dow Chemical Co. for industrial use and the remainder to the City of Freeport to supplement its present municipal supply of fresh water at a cost of $0.20 per 1,000 gal. Other objectives of the Freeport plant are: (1) to make corrosion tests to find the most economical materials of construction for long-term use, and (2) to enable the public to see saline-water conversion in operation.

The Freeport plant, built by the Chicago Bridge and Iron Co., is reportedly producing fresh water at about $1.24 per thousand gal, including all expenses for demonstration and experimental purposes. OSW reports that the knowledge gained from this plant will make it possible to design a 20-mgd plant that can produce fresh water for $0.50 per thousand gal.

Flash distillation

A multi-stage flash-distillation plant on Point Loma, San Diego, Calif., is designed for a capacity of 1 mgd; this plant will have 36 stages. A feature is prevention of scaling by flash evaporation. See Fig. 2.

The essential unit of a flash evaporator is a vessel maintained at a suitably reduced pressure into which the heated sea-water is sprayed. The water boils instantly and the steam flashes off. Whatever scaling may result occurs in the flash vessel, where it does not interfere significantly with the operation of the unit. Such a flash evaporator usually consists of a number of flash vessels in series, maintained at progressively lower pressures. The sea water is first heated in a unit that is completely separate from the flash vessel. Because of the low operating temperatures and the use of additives, scaling in the unit's tubular heaters is not expected to be serious.

Flash evaporation is especially suitable for locations where warm water in large amounts is already at hand, as is waste cooling water in chemical plants or the surface layer of a warm sea. The steam produced can be used to drive a turbine and produce power, before it is condensed for use as fresh water. Such a flash evaporator has been operated successfully as a pilot plant at the Univ. of California.

In the demonstration plant of the Office of Saline Water at San Diego, being built by the Westinghouse Elec-

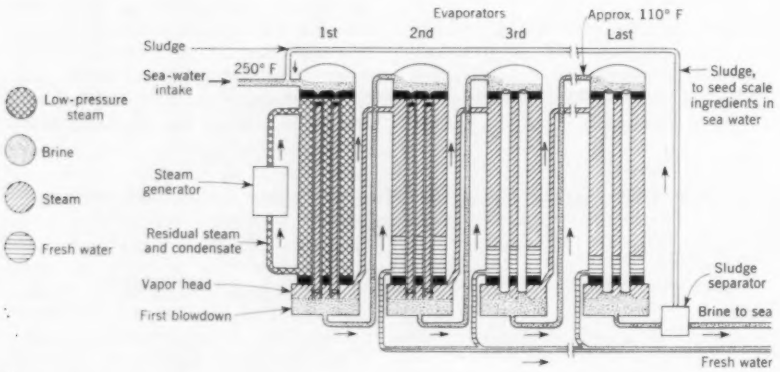


FIG. 1. In long-tube vertical-distillation process, saline water in the tubes is raised to boiling temperatures by condensing water vapor or steam on outside of tubes.

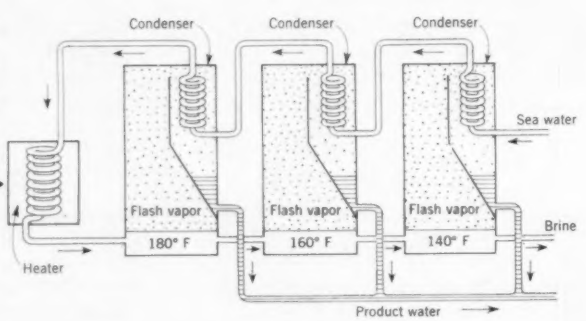


FIG. 2. In flash distillation process, sea water, sprayed into a vessel maintained at reduced pressure, boils instantly and steam "flashes off."

tric Corp., the sea water will be preheated under pressure and then introduced into the flash vessel, where the pressure is lower than the equilibrium pressure of the feed. As a part of the water flashes up in vapor, the temperature of the liquid naturally drops. The vapor flows around a condenser through which the feed water is passing. The remaining liquid travels on to the next effect, where the pressure is still lower and the cycle is repeated. The plant is intended to operate at a feed temperature of 200 deg F but may go higher depending on the success of new scale-control methods.

A plant for electrodialysis

Electrodialysis removes the salt from the water instead of removing a large amount of water from the saline solution, as in distillation. This method takes advantage of the fact that salts in water are in the form of negatively and positively charged ions. By applying an electrical potential across a vessel containing salt water, the ions are caused to migrate. Sodium ions move toward the cathode and chloride ions toward the annode.

Separation of the salt from the water takes place in an electrolysis vessel divided into compartments by means of membranes made of ion exchange resins. The simple three-compartment cell with two membranes shown in Fig. 3 illustrates the principal involved.

Materials for the two membranes are so chosen that one allows only cations (positively charged particles) to pass through it, and the other only anions (negatively charged particles). The membranes are so placed in the cell that when current is applied, the ions move from the central compartment through their respective exchange membranes into either the anode or the cathode compartment. That is, the anions move toward the anode and the cations move toward the cathode. At the same time the two membranes act as barriers to prevent ions from moving back into the central compartment. The result is that the water in the central compartment is effectively desalted.

Since the amount of electricity needed, and the current density, are directly proportional to the salt concentration, the method is not at present considered suitable for the purification of raw sea water with its salt content of 35,000 ppm or more.

In some large commercial cells in use today, an electrolysis stack may contain as many as 300 membrances. Suitable manifolds continuously separate the exit streams into fresh water and waste brine.

The OSW electrolysis plant at Webster, S. Dak., began operation last October to convert brackish well water. It was built by the Asahi Chemical Co. of Japan in cooperation with the Austin Co. Its design capacity is 250,000 gpd and it will electrolyze starting water with about 1,800 ppm of dissolved salts, bringing it down to about 300 ppm.

A vapor-compression plant

Turning a large amount of water into vapor to separate it from a relatively small amount of dissolved salts is inherently expensive. Therefore distillation processes are eminently suitable for use near a source of cheap fuel. Failing that, more efficient vaporization processes must be employed. One such process is the forced-circulation vapor-compression distillation method. It is an outgrowth of the small distillation units much used to provide drinking water during World War II.

In this process the vapor produced by boiling sea water is not condensed but compressed. Compression increases its energy content enough so that it can be returned to the evaporator to serve as the heating medium. After it has heated the incoming sea water, the compressed steam is condensed to provide the required fresh water. See Fig. 4.

The costs of the process vary inversely with the temperature of the operation, that is, as the temperature goes up the area of the heat-exchange surface and the size of the compressor

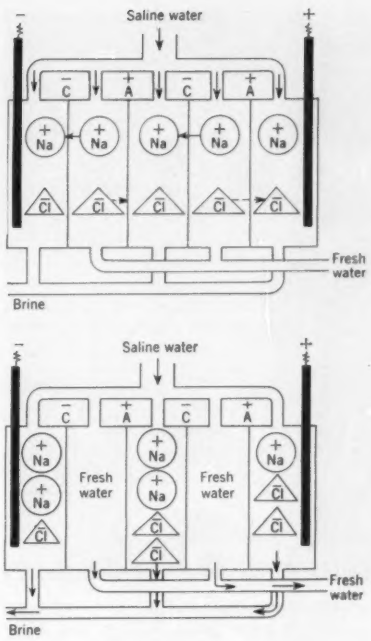
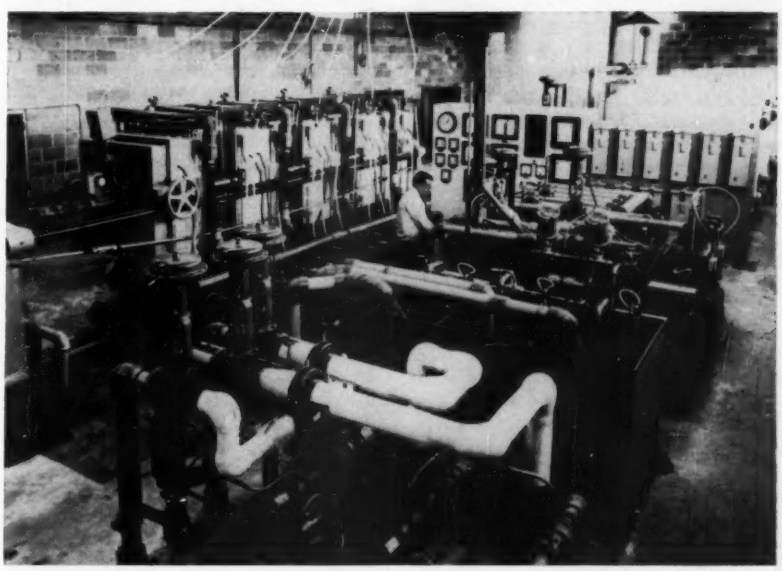


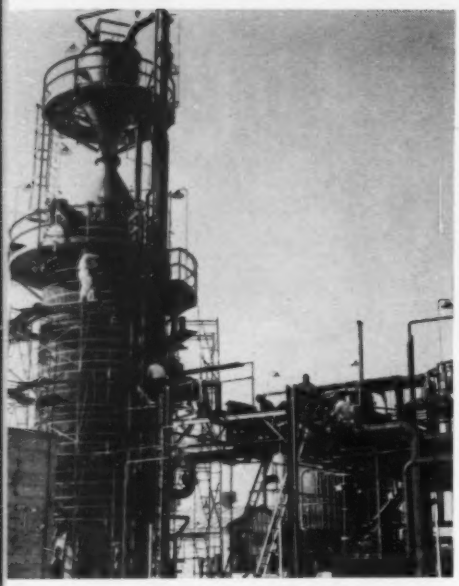
FIG. 3. In electrodialysis, salts are removed from the water through membranes that are one-way permeable. Sodium ions (NA) move toward the cathode and chloride ions (Cl) toward the anode.

go down. At high temperatures the old difficulty with scaling is intensified. Forced circulation of the feed increases heat exchange and decreases scale formation.

Roswell, N. Mex., is the site selected for the fourth demonstration plant planned by the OSW. It is to be



Electrodialysis system is being used at the Webster, S. Dak., demonstration plant. With a capacity of 250,000 gpd, this plant will convert brackish well-water with 1,800 ppm of dissolved salts to an end product with about 250 ppm.



Melter-washer tower of a pilot salt-water conversion plant being built by the Blaw-Knox Co. at St. Petersburg, Fla., is shown under construction. Designed to produce ice crystals—of pure water—this plant will use liquid butane. Target price for the 35,000-gpd installation is less than 50 cents per 1,000 gal. Photo courtesy Pittsburgh Corning Corp.

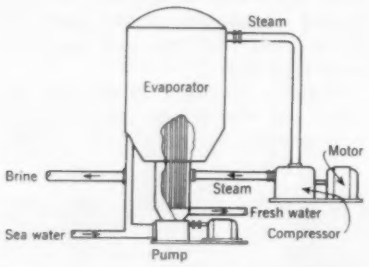


FIG. 4. In forced-circulation, vapor-compression distillation method, vapor from boiling sea water is compressed and made to serve as a heating medium. After heating the incoming sea water, the compressed steam is condensed to provide fresh water.

a forced-circulation, vapor-compression unit with a design capacity of 1 mgd of brackish well water. It is expected that the plant will be operated at above 212 deg F. The OSW feels that this type of distillation is capable of maximum fuel economy. Scale will be prevented by either an ion exchange pretreatment system or the use of a calcium sulfate slurry scale-prevention system. Bidders can select either of the above.

A freezing-process plant

Desalting of water by freezing has the natural advantage of an inherently low energy requirement. Also the process can be accomplished at or near atmospheric pressures and at low temperatures, which minimize scaling and corrosion. The basic simplicity of the process has the additional advantage that low-cost materials and equipment of reasonable size can be used in plant construction.

The fifth plant in the present OSW demonstration-plant program will apply the freezing principle. Although direct freezing appears to be the most advantageous method, it has not been decided whether the direct or indirect process will be used. The OSW is preparing performance specifications for competitive bidding. With a design capacity of 250,000 gpd, the plant will treat sea water at Wrightsville Beach, N. C.

One of the first direct freezing processes investigated was that developed by the Carrier Corporation. See Fig. 5. Deaerated sea water is precooled by loss of heat to the brine effluent and the fresh-water product streams. The feed is further cooled to 25 deg F by evaporation, whereupon it is practically frozen. The ice-brine slurry is pumped to the bottom of a separation column, where the ice and brine are initially separated by a screen. The ice moves to the top of the column and the brine is recycled to the freezer and thence to waste.

Water vapor leaving the top of the freezer is absorbed in a lithium bromide solution. The diluted absorbent is regenerated by heat; the steam produced is condensed; and the condensate is used for washing the ice in the wash column. The concentrated absorbent is recycled to the absorber. Fresh water flows countercurrent to the ice rising in the column.

The ice is scraped into a melting tank where it is melted by recycled fresh water. The effluent from the melting tank is divided into three streams. The largest stream flows to the absorber, where it picks up the heat of absorption. The same stream flows through a chiller to preserve heat balances and then flows back into the melting tank to melt more ice. The second stream is used for washing the ice at the top of the column and the third stream is product water, which is heat interchanged with incoming feed and thence goes to storage and distribution.

In the direct process developed at Cornell University, the water is frozen by the evaporation of a refrigerant, liquid butane, directly in the brine. See Fig. 6. The resulting ice-brine slurry enters a washer where the ice is rinsed and separated. The ice goes on to a melter where it is melted by compressed refrigerant vapors collected at the freezer. The refrigerant is of course insoluble in water and is recovered for further use. It is reported that ice made with butane can be washed almost completely without melting.

Propane will be used in a somewhat similar way in a pilot plant now being designed by Koppers in cooperation with the Office of Saline Water. When sea water is cooled to 35 deg F and mixed with propane, hydrate crystals form around the propane molecules. The crystals are washed free of salt and pumped to a decomposing chamber to which the propane is also pumped under pressure. Here the

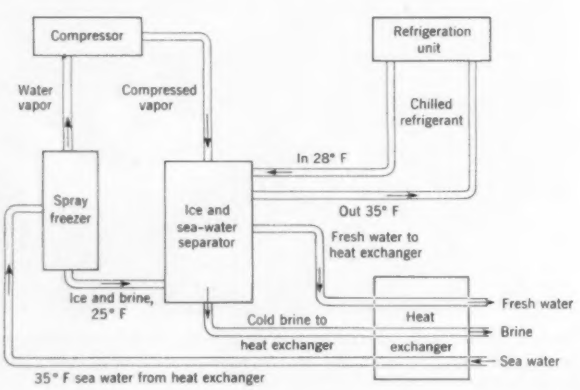


FIG. 5. In direct freezing process, as developed by the Carrier Corporation, deaerated sea water is precooled, then frozen by chilled refrigerant.

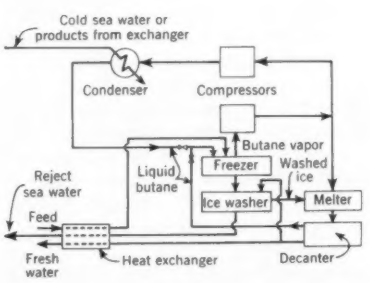


FIG. 6. In direct freezing process as developed at Cornell University, liquid butane serves as the freezing agent. Courtesy Blaw-Knox Company.

condensation of the propane releases heat to melt the hydrate crystals. Since the resulting fluids, pure water and propane, do not mix, they are easily separated as they flow out, and the propane is returned to the reaction vessel. Low cost, less than 50 cents per 1,000 gal, is predicted for this process when perfected.

Future possibilities

Although solar distillation was not selected as one of the processes for the first five demonstration plants, much has been learned about this process both here and abroad. While it is doubtful that large-scale solar distillation will ever be practical in the United States, it may well be successful in small units in warm, dry areas where there is plenty of sunlight.

Advances in solar distillation have been in the direction of lowering the cost of equipment and increasing the efficiency with which the solar energy is utilized. Valuable data have been obtained through the operation and development of basin solar-still prototypes and small pilot plants. Tilted-type and suspended-type stills are also being evaluated at test sites.

Much of the development effort in recent years has been devoted to freezing processes. Data obtained so far support previous predictions that fresh water obtained through the ice cycle will be competitive in cost with that obtained from the most advanced distillation processes.

A 15,000-gpd pilot plant, in which ice is formed by vaporization of part of the sea-water feed, and which has been operated on synthetic sea water, has been moved to a sea-coast site at Harbor Island, N. C., and placed in operation. A 35,000-gpd pilot plant that will use butane as a secondary refrigerant, and incorporates two different freezing and washing techniques, is in operation at St. Petersburg, Fla. A new approach, which involves control of the size of the ice crystals, has been demonstrated with small pilot equipment.

Several of the distillation processes are the farthest advanced to date. New large commercial installations in water-short areas have been announced, multistage flash distillation being the preferred process for the conversion of sea water. Methods of scale control have received much attention. The pilot equipment used to develop the sludge-control technique incorporated in the first demonstration plant constructed (long-tube, vertical, multiple-effect) has continued in operation to develop means of controlling calcium sulfate scale. Experimental work has been undertaken on multiple-flash systems to evaluate the effects of additives and sludge techniques.

Progress has been made in the development of the vapor-reheat, multiple-flash process through laboratory research, particularly in liquid-liquid heat-exchanger development. As a result of laboratory tests with the new wiped-film evaporator, a prototype is now being built. A phase of the rotary vapor-compression still has been completed, and additional research has been recommended. The atomized suspension technique has been under investigation as a possible means of brine disposal.

Membrane processes continue to show promise as an important means of converting saline waters. Commercial development of electrodialysis has continued, with considerable increase in the number of installations treating brackish waters all over the world. Research and development under way at the Bureau of Reclamation's laboratories in Denver have been expanded and now include a field test site where brackish well-water is available. Several different types of membranes have been tested for electrodialysis. Four different types of electrodialysis units have been procured and are being evaluated.

Electrodialytic processes are related to ion-exchange technology, since ion-exchange types of materials are used in permselective membranes. However, interest is growing in other ways of using ion-exchange resins for saline-water applications. An example is the work initiated during the past year in the use of special ion-exchange materials to remove scale-forming components before distillation, the concentrated brine effluent being used to regenerate the resins.

Solvent extraction, that is, the use of organic solvents to remove fresh water from saline, has been the subject of further study and laboratory research. It continues to show promise as a possible economical process for treating brackish waters in the 5,000- to 10,000-ppm range.

In regard to costs it can be stated that just 10 years ago the conversion of sea water to fresh water by distillation processes produced fresh water in small quantities at costs of $4.00 to $5.00 per 1,000 gal. It is generally agreed that the lowest cost of fresh water produced from existing large sea-water distillation plants is approximately $1.75 per 1,000 gal. The OSW estimates costs for more advanced distillation processes to be about $1.00 per 1,000 gal for plants in the 1-mgd range. This includes writing off the equipment but not experimentation expenses. Conversion plants of smaller size for brackish water using the electrolytic process can produce fresh water for about $0.75 to $1.00 per 1,000 gal.

OSW Director MacGowan has been quoted as stating to a Congressional committee that some phenomenal new process would be necessary to bring conversion costs below 50 to 60 cents per 1,000 gal. Research is the answer. Time and money and manpower for additional research are the keys to economical desalinization.

Credit must be given to manufacturers of equipment used for the conversion of saline water. Many such manufacturers maintain research facilities for the development and improvement of equipment. Griscom-Russell, pioneers in land-based conversion plants and suppliers of equipment for the majority of all United States ships in service, operate a Marine Test Laboratory at Wrightsville Beach, N. C., where continuing tests are in progress under actual service conditions.

In Millstone Point, Conn., the Maxim Evaporator Division of the American Machine and Foundry Co., another leader in sea-going plants as well as land-based facilities, operates a marine saline-water testing laboratory where plants are tested on full-density sea-water and new materials and designs are checked. Many other manufacturers also contribute to the improvement of the equipment through research facilities and in-service tests.

Still in the experimental stage

That saline water conversion is just coming out of the experimental stage is a fact conceded by all. The demonstration plants of the Office of Saline Water are just that—plants to demonstrate the validity and feasibility of various types of equipment and techniques. There will be failures demanding new approaches, and there will be progress demanding money. The government is ready to spend the money.

The $75,000,000 approved by the last Congress for further work in this field—an amount equal to 3½ times the total spent by the government thus far—puts us in the saline-water conversion business all the way. More research and more plants are coming. Only the future will reveal our wisdom.

The author is indebted to Samuel B. Morris, F. ASCE, consulting engineer of Los Angeles, to R. H. Jebens of the Office of Saline Water, and to the many manufacturers of equipment who provided data for this article.

A center for shockproof shopping

GORDON D. FRIEDLANDER, formerly Project Engineer, P. T. Mikluchin & Associates, Ltd., Toronto, Canada

A sharply sloping site with special grading problems and a location subject to major earthquake damage—these two related physical problems were faced by the designers of the Brentwood Park Shopping Center in Burnaby, B. C., about 5 miles from downtown Vancouver. This article is mainly concerned with the design of the department store building provided for Eaton's of Canada, at the eastern end of the center. See Fig. 1.

Deep cut poses problem

The building for Eaton's of Canada consists of two stories and basement, with the foundation in an area of deep cut. At the northern end of this cut is the toe of a high embankment, the top of which was graded approximately to the same elevation as the roof of the Eaton store. A level access bridge could then be constructed to serve the rooftop parking area.

In the preliminary stage of the design, a combination retaining and bearing wall 53 ft high, to form the north side of the store, was considered. In theory, this wall would be designed to retain the large earth charge created by the deep cut, to resist the lateral thrust of anticipated seismic forces, and to form the exterior bearing wall for the structural framing. However, further investigation revealed that, with this arrangement, much of the earth thrust would be transmitted throughout the entire structure, necessitating abnormally massive column and girder systems. This prospect, plus the high cost estimated for the construction of such a combination wall, ruled out this design.

By substituting shear walls for the retaining walls, the weight of steel in a typical interior bent in the short direction was reduced from 80.2 to 40.5 tons, and for a typical bent in the long direction, the steel was reduced from 29.8 to 16.8 tons.

The writer was project engineer with P. T. Mikluchin & Associates, Limited, the consultant, who designed the structure. He worked closely with Dr. P. T. Mikluchin in formulating the alternative solution to this interesting design problem. The soil reports indicated a predominance of glacial till with good bearing values (about 10 kips per sq ft). It was therefore decided that, if the 53-ft-high embankment was graded to a slope of 1 on 1, the safety factor would be adequate. This slope was therefore established for the embankment, which was faced with a 2-in. layer of reinforced gunite. This arrangement eliminated the necessity for a high retaining wall and freed the building structure completely from any lateral earth thrust acting above the basement level.

Design for earthquake forces

A rooftop parking area was planned for the entire parking center. To permit access to it, a beam-and-girder bridge, with appropriate seismic joints consisting of Lubrite plates at the abutments, was designed to span the V-notch created between the building and the top of the embankment. See Fig. 1. The width of this bridge is about nine bays (216 ft) and its span is about 32 ft.

For earthquake Zone 3, in which the building is located, the earthquake design factor, according to the National Building Code of Canada, is as follows:

$$\frac{0.15}{N + 4\frac{1}{2}} \times 4$$

in which N is the number of stories below the roof. This factor, multiplied by the dead load of the structure, gives the assumed lateral earthquake force, in kips, acting at each floor of the building. This same factor is used in California building codes and in most areas of the United States where seismic forces must be taken into consideration.

Because the structure is a department store, requiring large areas of open floor space unencumbered by structural cross-bracing, an ingenious combination of exterior and interior shear walls was devised to eliminate seismic-produced moments on many interior columns and to permit pin connections at the footings.

The structural-steel skeleton was originally designed as a two-way, continuous, all-welded structure, with bays 24 ft x 24 ft, and a beam spacing of 8 ft. On the basis of a live load of 100 lb per sq ft assumed for the mall and upper levels, the majority of the interior beams were specified as 14 WF 34, and the girders, as 24 WF 76. The floor system is a 2½-in. reinforced-concrete fill poured into 22-gage metal decking, which serves only as formwork and not as an integral part of the floor structure. This being the case, the corrugated metal decking is not considered in determining the fire-resistivity of the building.

FIG. 1. Model of Brentwood Park Shopping Center, in Burnaby, B.C., Canada, shows Eaton's of Canada department store (right), the truck concourse (left), service building area (top, center), and Loblaw's (top, left).

The design philosophy of this construction is based essentially on the logical assumption that the earthquake forces will be transmitted by the diaphragm action of the floor system to the 8, 12 and 16-in. reinforced concrete shear walls along column lines A, K, 36 and 44X (Fig. 2). The 12-ft cantilever at line 44X presented a difficult problem, which was solved in a very imaginative, yet entirely sound manner.

As may be seen from Section A-A (Fig. 2), the discontinuous shear wall in the end bays was splayed out to form the architectural soffit of the cantilever. This part of the shear wall actually forms an open Z as it continues from the mall level to the soffit to the upper level. A seismic thrust on the upper section of the wall causes a change in the load on the ends of the cantilever beams and a shear in the sloping diaphragm.

Large moments in exterior columns

To resist the large penultimate moments, totaling 232 kip-ft, in the exterior columns due to the cantilever structure and the seismic forces, massive, built-up "cruciform" structural columns were employed at the building corner and adjacent columns, while heavy built-up members, reinforced by steel channels, form the intermediate columns along the line supporting the cantilevered end of the structure. See Fig. 2, Section A-A.

The prolonged steel strike of 1959, and the consequent depletion of inventories, presented us with a major redesign problem. Open-web joists spaced 4 ft on centers were perforce substituted for the rolled sections originally specified, mainly the 14 WF 34's, spaced at 8 ft. Thanks to the cooperative efforts of the Dominion Bridge Company of Vancouver, the structural steel fabricators, mutually satisfactory substitute moment connections were worked out and used where the open-web joists

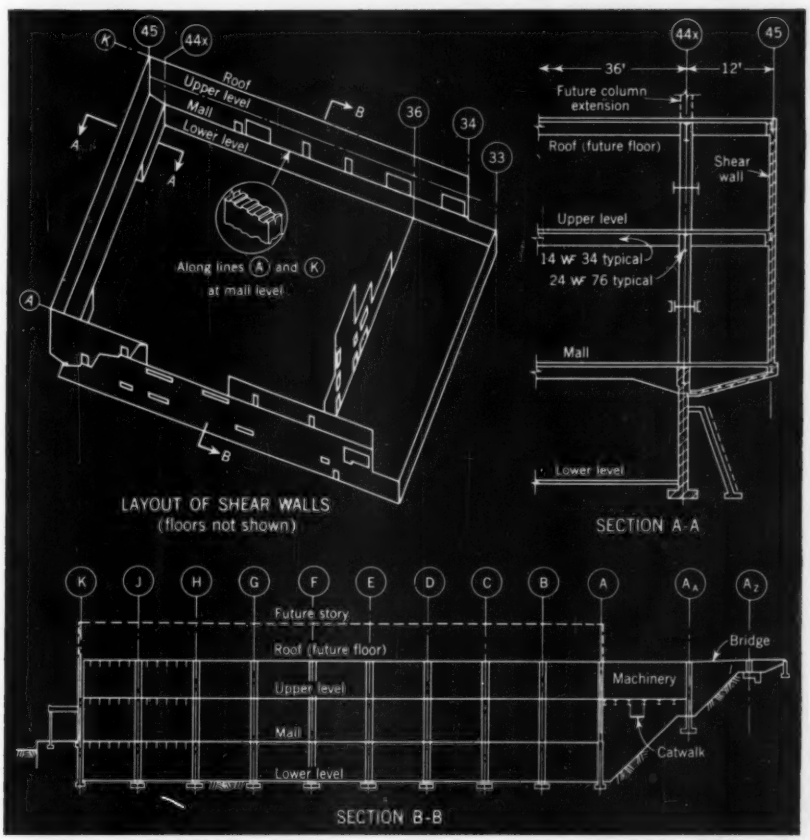


FIG. 2. Layout of shear walls for Eaton's of Canada, with floors shown in cross section.

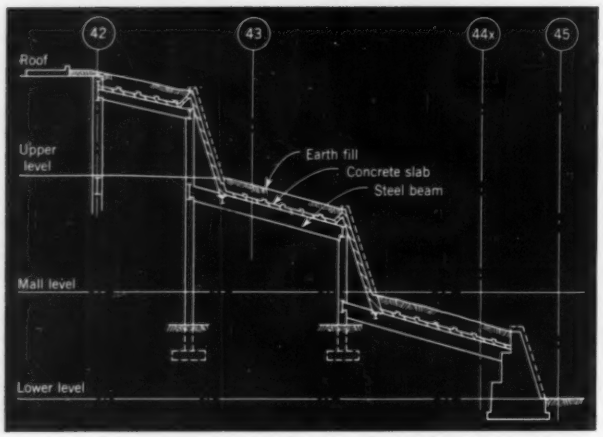
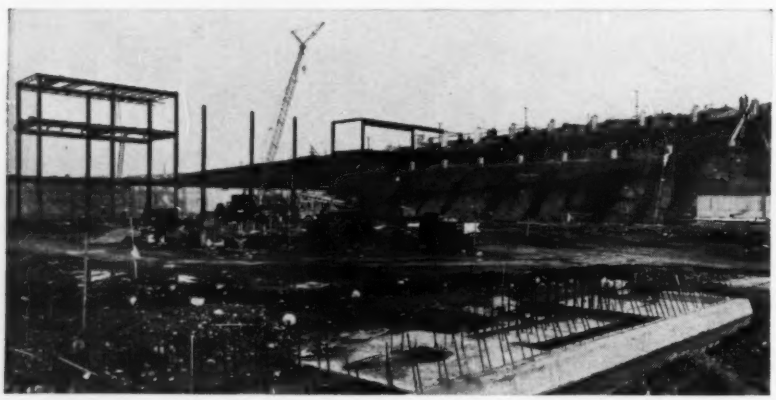


FIG. 3. Embankment at north end of store is terraced with steel-beam and concrete-slab construction for architectural effect. For location of this embankment, see Fig. 1.

Form work and placing of reinforcement proceeds for abutments that will carry access bridge leading to Eaton's rooftop car parking area.



Steel is being erected along access bridge abutments to span high embankment at rear of site. Lower tier of piers along embankment were formed using Sonotubes.

frame into the columns, thus assuring full continuity in both directions. Because of the acute shortage of rolled sections, Dominion Bridge fabricated some 150 built-up equivalent column and girder sections from welded plate. The rest of the columns and girders were obtained from either British or American mills.

Erection sequences

Other interesting features were the erection sequences and techniques for the foundation walls, the structural steel, and the shear walls. It was decided that steel bents were to be utilized on lines A, K, 36 and 44X so that the framework could be erected independently of the shear walls. Holes were provided in the beams and columns to allow reinforcement to pass through, and shear connectors were welded to all the members at intervals.

The concrete foundation walls were first placed up to the mall level, and pockets were provided in which the columns were to be erected. To make way for the column erection, the reinforcing bars passing through the pockets were cut and bent outward. After the columns were positioned and held by anchor bolts, these bars were straightened and welded together to form continuous reinforcement, and the pockets were filled with concrete flush to the top of the poured foundation walls.

To furnish additional strength in shear and bond between the first-pour foundation walls and the subsequently poured shear walls, castellations were formed in the top surface of the foundation walls along lines A and K at the mall level (Fig. 2). Also Nelson studs were provided at about 3-ft intervals along the flanges or the webs of the columns, or both, to insure maximum bond and transmittal of stresses when the steel was embedded in the concrete shear walls. Some of the floor beams, which were partially encased in the shear walls, had zigzag reinforcing rods welded to the top and bottom flanges. Of course the steel embedded in the shear walls did not receive the customary shop coat of protective red lead.

The Eaton's of Canada department store is designed so that another story can be added at a later time. With this addition in mind, the boiler room, transformer vaults and spaces for other machinery were placed, as shown in Section B-B (Fig. 2), on the upper level beneath the rooftop access bridge. Provision also was made for raising the elevator machinery in the penthouse to provide for the additional story. To permit an escalator rise, knock-out panels, with bolted structural framing con-

nections, were installed at the roof level. A temporary architectural cupola or monitor now tops out the escalator wells. Another elevator shaft was included for the installation of a future lift facility. This shaft is temporarily covered at each floor level by precast concrete slabs, and openings for future elevator doors have been made in the Line 36 shear wall. These openings are now bricked up.

In view of the possible vertical expansion, the roof was designed for a live load of 100 psf, although 75 psf is permitted for rooftop car-parking areas.

Because of the radical departure from conventional design, and to preserve the required esthetic features of the architectural design, the curved and stepped retaining walls at the north end of the site actually terminate in masonry-faced structural steel falsework near the building line. The falsework is designed to support two feet of earth fill for planting purposes. This treatment was necessary, of course, to meet proposed finished grades and to conceal the deep V-notch trench at both ends of the access bridge system. This solution is shown in Figs. 1 and 3.

The project area of this shopping center consists of a number of mall-level variety shops, a restaurant, a bank and a huge Loblaw's supermarket. A truck concourse, covering an area of about four acres, was built over many of these stores. Narrow rooftop structures, also shown in Fig. 1, serve for storage and to accommodate transformer and mechanical equipment for the shops below. As the total height of the truck concourse, excluding the storage superstructures, is less than 25 ft, a waiver was obtained, making it unnecessary to apply the seismic factor to the general area.

Truck concourse provided

The truck concourse is designed for an H15 loading, which for the spans employed, equals a live load of 250 psf. The structural-steel girder system is continuous, while the steel beams are framed and designed as simple-span connections. The flooring consists of poured-in-place reinforced concrete slabs, 5 to 8½ in. thick. The slabs are topped by a 2-in. asphalt wearing surface. A ¾-in. layer of Cafco sprayed-on asbestos insulation was applied below the slabs.

Test borings indicated that the soil in the project area was a glacial till with large embedded boulders and was generally unfavorable for the use of isolated spread footings. A test was made with standard Franki displacement caissons with expanded base. Blows of 140,000 ft-lb broke up or pushed aside the boulders and gave the desired penetration. A total of 292 Franki caissons, from 7 to 20 ft long, were installed.

In developing the structural design for the store of Eaton's of Canada, the writer as project engineer, Fred L. Williams as senior structural engineer, and the engineers and designers working under Dr. Mikluchin, cooperated closely with the architects to insure that the heavy shear walls would blend into the interior and exterior architectural features. Altogether, it proved to be a most satisfactory collaboration among structural, mechanical, electrical and site engineers and architects. The necessary structural integrity was achieved without adversely affecting esthetic considerations. There was no sacrifice either of usable interior sales space or of the functional occupancy of the building as a multi-service department store.

The total construction cost of the Brentwood Shopping Center was $10 million. The principals participating in its design were:

Architects, The Graham Co., Toronto

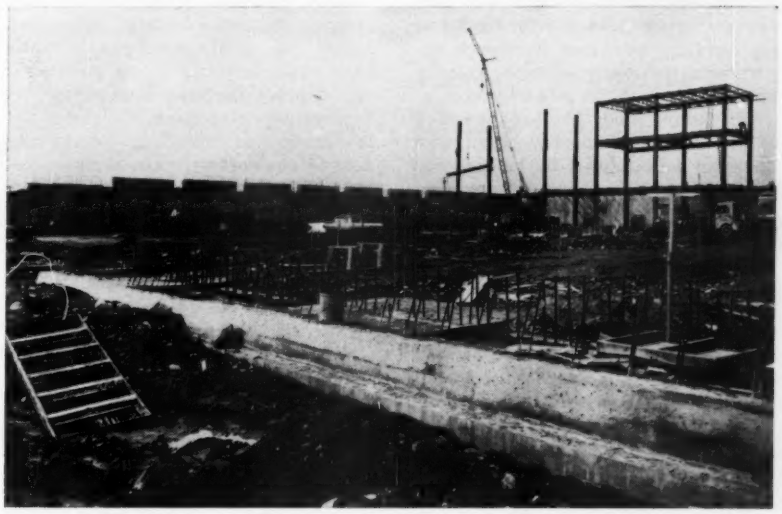
Structural Engineers, P. T. Mikluchin & Assoc., Ltd., Toronto

Interior Designers, Welton Becket, Los Angeles

Mechanical and Electrical Engineering, Paul Ellard, Toronto

Site Engineering, Reginald Cave, Vancouver

Construction, Webb & Knapp of Canada, Ltd.



Columns are being erected in "pockets" of combined foundation and shear wall along K line in background. For position of this wall, see Fig. 2.

In aerial view, structural framing for Eaton's of Canada is rising in foreground. Steep embankment at left is already spanned by one bay of access bridge to rooftop parking area.

ASCE NEWS

United Engineering Center Is Dedicated

November 9 was hailed as a day of rejoicing "among the engineers in the United States" by former President Herbert Hoover and other dignitaries who spoke at the dedication of the United Engineering Center, in New York, on that day. All speakers, including the vicars of three faiths who pronounced invocations, saw the Center as representing new and increased opportunities for the profession to serve mankind through the arts of peace.

Mr. Hoover said, "We have dreamed of this building for many years. . . . We have believed that by housing our 20 different societies under one roof we would have more unity of purpose in our profession. . . . We have believed that we could be of more service to the American people." On behalf of the engineers of the United States, he dedicated the Center "to the service of mankind."

Dignitaries from all areas of American life, as well as foreign engineering groups and governments, sent greetings and messages. Greetings were delivered by representatives of President Kennedy and Governor Nelson Rockefeller, of New York State. New York's mayor, the Hon. Robert F. Wagner, delivered his greeting and congratulatory message in person.

In the keynote address, Dr. Eric A. Walker, president of the Pennsylvania State University, declared that "the rescue of under-developed nations from their desperate living conditions will depend, in major degree, on the engineering profession." Calling attention to the essentially "moral nature of engineering," Dr. Walker said that, "If engineers are to be accorded full citizenship in the society of man, they must accept full responsibility for the exercise of their own talents, their own abilities, their own skills. Where they can lead more wisely, more sanely than others, they must do so."

One of the program highlights was a talk by William Hallerberg, senior honor student at the Missouri School of Mines and Metallurgy, who had been chosen to address the dedication in the name of the coming generation of engineers. He stated: "Here, then, is the real challenge to us, the engineers of tomorrow. True, it will be our responsibility to design larger buildings, to build higher-flying aircraft, and more reliable rockets. But if we are to do these things in the world of tomorrow, it is also our responsibility to make sure that there is a world for us to work in. Perhaps we can replace the jealousies, the unreasonable hatreds, the insane competitions that dominate international relations and substitute the rational approach that has brought such progress in engineering and science."

During the ceremony Dr. Mervin J. Kelly, former chairman of the Board of the Bell Telephone Laboratories, Inc., received the Hoover Medal for "distinguished public service" (page 78). Presentation of the medal to him was made by former President Hoover, in whose honor the award was established in 1929.

The dedication was attended by

N. Y. C. Commissioner Carroll (right in left-hand photo) honors the United Engineering Center, in behalf of the city, by temporarily changing the name of East 47th Street, in the UEC area, to Engineers Plaza. Response for the Center was made by Willis F. Thompson (left), president of United Engineering Trustees. View at right shows the Center's new flag going up against a background of flags of the member nations of the United Nations (loaned for the occasion by the city). An Air Corps band from Stewart Field, N. Y., played the National Anthem as the flag was raised.

some 700 engineers and guests. Willis F. Thompson, president of United Engineering Trustees, Inc., was master of ceremonies.

Before the dedication exercises began, Mr. Thompson represented the occupants of the Center at another ceremony, in which city officials temporarily renamed East 47th Street, in the UEC area, Engineers Plaza. This ceremony was followed by flag raising at the UEC—an impressive ceremony that took place against a background of United Nations flags (loaned by the city to the UEC for the occasion), with an Air Force band playing "The Star Spangled Banner." The new flag was the gift of the nonprofessional employees of the Center.

Arriving for the dedication ceremonies, former President Herbert Hoover is greeted by ASCE Past President Daniel V. Terrell (left), a prime mover in initial efforts to obtain a new engineering societies headquarters; Executive Secretary William H. Wisely; and President G. Brooks Earnest.

ASCE Takes Part in Conference on Fundamental Research in Plain Concrete

That progress is being made in understanding fundamental aspects of the behavior of plain concrete was evidenced at the Second Conference on Fundamental Research in Plain Concrete. Meeting at the University of Illinois in the early fall, some 100 people from universities, government agencies, research foundations, and professional societies discussed various phases of cement and concrete technology.

Co-sponsors of the conference were the Structural Division of ASCE, the University of Illinois, the American Concrete Institute, the Reinforced Concrete Research Council, the Portland Cement Association, the American Society for Testing and Materials, and the National Science Foundation.

A discussion on the microscopic view of fracture represented mainly by the Griffiths theory was of great interest to the group. Griffiths hypothesis recognizes the importance of breaking the molecular bond or Van der Waals forces near flaws or cracks in a material. The theory relates the work done in breaking these bonds to the surface energy associated with crack extension. Numerous investigators related results concerning cracks in the aggregate; cracks at the aggregate-paste interface; cracks from the inside and the outside, in drying concrete and wet concrete; and cracking under various loading conditions. Some of these tests seemed to verify the Griffiths theory while others did not. Generally it was concluded that the Griffiths theory was a good starting point but all the details of its application to concrete were a long way from being described in great enough detail to permit its direct application in practice.

Discussion at a session devoted to the origin and nature of strength revealed that at the present time there is no quantitative theory for the predetermination of the strength of concrete. It was concluded at the end of the sessions that to penetrate such barriers to understanding in all areas, a breakthrough is needed in understanding the nature, origin, and strength of bonds that exist in concrete in all phases of mixing and curing, behavior under load, and fracture.

Many of the researchers attending the conference indicated that the direction of their research would be altered significantly in light of their new knowledge.

The improved cooperation and increased communication between the scientist and the engineer, as evidenced by this meeting, is certainly a condition upon which efficient and more rapid progress depends.

Leo H. Corning represented the ASCE Structural Division on the Conference Steering Committee, which was headed by Prof. Clyde E. Kesler, F. ASCE, of the University of Illinois.

[CIVIL ENGINEERING is indebted to Gene Nordby, F.ASCE, for the material on which this item is based.]

Freedom to Talk Back

Twenty-one years ago, Dean T. R. Agg, then chairman of the ASCE Committee on Publications, emphasized the duty of Society members to offer their technical knowledge as "testimony" to support or disprove some technical proposal in theory and practice, by reading papers critically and by entering their own discussions. Writing in an article entitled "Freedom to Talk Back," in the September 1940 issue of CIVIL ENGINEERING, he said:

". . . Discussion is more than a privilege—it is a duty, to the Society and to the profession as well. Furthermore, each member in joining the Society undertakes to give the profession the benefit of his technical knowledge. All of these factors and, in fact, every consideration tend to encourage the widest discussion."

This plea, addressed to 17,000 members in 1940, is even more important, addressed to 48,000 members today. Active participation in a large organization sometimes seems extremely difficult, especially to the members far from a meeting center. There is room for only one President, four Vice Presidents, nineteen Directors, and about 2,000 special committee, Technical Division, and Local Section officers. This is a large number, but there is room for 49,000 discussers, and their places are not subject to elections, appointments, or casual selection.

The Society is a meeting ground for the exchange of technical and professional ideas and it prospers in proportion to the number of its active participants. In a very real sense, it is a forum in which each individual member of the Society can "talk back."

Houston the Host for Next Convention

The Winter Convention of ASCE, programmed on the theme of "Planning and Building for Industrial Growth," could find no more appropriate setting than Houston, the nation's seventh-ranking metropolis and the heart of a multi-billion-dollar industrial complex. The Texas Section of ASCE, host to the Convention, has planned a traditionally warm Southwestern welcome for Convention visitors and their wives, and a series of interesting technical papers and discussions will feature a number of the country's foremost authorities on space-age industrial planning and construction.

Houston's Shamrock-Hilton Hotel, famed for its hospitality and elegance, will be the headquarters for the Convention, February 19-23, 1962. Bramlette McClelland is general Convention chairman.

The Convention committee has scheduled a special series of boat trips down the Houston Ship Channel, to give visitors a close-up look at the world's largest concentration of oil refining and petro-chemical development.

Entertainment highlight of the Convention will be a chance to see the nation's leading cowboys risk their necks in competition at the thirtieth annual Houston Fat Stock Show and Rodeo, rated among the nation's top three expositions of its kind. A special block of tickets has been reserved for ASCE Convention visitors.

Post-convention trip to Mexico

For visitors who want to extend their Houston Convention trip south of the border, conducted post-convention air tours to Mexico City and Acapulco are available. The Mexico City trip (three nights and four days; $123) and the Mexico City-Acapulco jaunt (six nights and seven days; $237) include all hotels and meals in Mexico. Round-trip air fare from Houston is $88 to Mexico City, and air transport to Acapulco is $23 additional.

The featured luncheon speakers include Karl Bendetsen, board chairman of the Champion Paper and Fibre Company, and Brig. Gen. A. W. Betts, director of military application, Atomic Energy Commission. A. Allan Bates, vice president of research and development for the Portland Cement Association, will preside.

Promising technical program

Papers and symposiums scheduled by the Society's Technical Divisions present discussions of civil engineering in the fields of pipeline construction, offshore oil and gas operations, jet-age airport construction, water supply, and soil mechanics. Several discussions of the engineering aspects of Hurricane Carla are also planned for the Convention program.

The Soil Mechanics Division will hear a paper by John A. Focht, Jr., of Houston, on strut-load measurements involved in design of the 44-story Humble Oil & Refining Company skyscraper, the tallest office building west of the Mississippi, which is now nearing completion in Houston. Space-age engineering will be reflected in a symposium on hardening ballistic missile bases to resist shock from atomic explosion.

Another up-to-the-minute symposium will deal with the engineering for Houston's recently dedicated Jetero Intercontinental Airport, the second air terminal in the nation planned from scratch as a jet-age airport. Appearing in this symposium will be Frank H. Newnam, Jr., N. P. Turner, and R. O. Grimes, of Houston; and A. O. Quinn, of Philadelphia.

The Structural Engineering Division program will emphasize design in metals. John V. Scalzi, of Pittsburgh, is to present a paper on designing with high-strength steels. T. R. Higgins, of the American Institute of Steel Construction, will give a paper on the new AISC design standards.

The Surveying and Mapping Division will hear a paper on the effect of subsidence upon surveys, presented by Prof. Raymond Dawson, of the University of Texas. Survey problems peculiar to the petroleum industry will be discussed in a paper by Virgil Walston, of Houston. Earle J. Fennell, of the U.S. Geological Survey, will discuss surveys and maps of industrial growth; and geodesy in the missile age will be the subject of a paper by Lansing G. Simmons, chief mathematician of the U.S. Coast and Geodetic Survey.

Gunnar Sigurdsson, of the University of Iceland, will be one of the participants in a symposium on wave forces programmed by the Waterways and Harbors Division. Technical discussions by this Division will include wave statistics during Hurricane Carla; the effect of wave forces on piling and structures, with particular reference to offshore oil and gas drilling operations; and a discussion of the effect of hurricane wave forces on breakwater capstones. Weldon M. Gamel, of the U.S. Corps of Engineers district office at Galveston, Tex., will present a paper on the effects of Hurricane Carla, the most destructive

Port of Houston's famous Turning Basin, where ships from all over the world turn around after discharging and loading cargo. The Port of Houston is on a 50-mile-long Ship Channel, which connects the city with the Gulf of Mexico. Industries and dock facilities, valued at more than $2.5 billion, line both sides of the Ship Channel.

storm on the Gulf Coast since 1900.

Henry S. Norman, of Houston, will discuss the City of Houston's water development of the Trinity River—a project that will ultimately develop a 1,200-mgd industrial water supply for the area's gigantic industrial complex.

Pipeline Division sessions will be highlighted by several interesting discussions of particular significance to the petroleum industry. A progress report of the Committee on Pipeline Crossings of Railroads and Highways will be given by Leroy Busa, of Chicago. A symposium on petroleum-handling facilities will deal with the problems involved in marine docking of supertankers. Joseph Kreig, of Houston, will present a paper on design and construction practices of offshore pipelines.

Refrigerated LPG storage in pipeline operations is the subject of a paper by Gerald Engdahl, of Chicago; and mined underground storage for pipeline terminals will be discussed by Sidney Scisson, of Tulsa.

The "critical path" method of project planning and scheduling, used effectively in Defense Department missile program execution, will be described in a Construction Division paper by Herbert Berman, of Ambler, Pa., with particular reference to its use in other construction fields.

A space-age highlight of the Construction Division sessions will be a paper by James Travis, manager of the Hanford Atomic Products Operation at Richland, Wash., on unusual aspects of design and construction of a large plutonium production reactor.

D. C. Greer, Texas State Highway Engineer and former president of the American Association of State Highway Officials, will participate in a Highway Division symposium on the Federal Interstate Highway program. Another Highway Division symposium will scan the available data on the WASHO road tests, now concluded but still under examination.

The full technical program will be printed in the January issue of CIVIL ENGINEERING.

Social program of wide appeal

A number of special entertainment features for the Houston Convention, in addition to the Houston Fat Stock Show and Rodeo, have been planned by the host (Texas) Section. These include a welcoming buffet and cocktail get-together on the evening of the Convention's opening day; a Tuesday luncheon and style show for the ladies at one of Houston's finest country clubs; and a bus tour of the famed Houston Medical Center, followed by a tea at the Rice University Faculty Lounge on Thursday, for the ladies. There will be a room at the Shamrock-Hilton, where coffee and Texas-style hospitality are available at all hours.

Reservations for the post-convention tours to Mexico City and Acapulco are being handled by Jose Correa, ASCE Excursion Committee Chairman, through the E. F. MacDonald Travel Co. at 36 South Wabash Avenue, Chicago 3, Ill.

Planning ASCE's Houston Convention, to be held February 19-23, are three leaders of the Texas Section and a staff adviser from ASCE headquarters. Left to right are Bramlette McClelland, general Convention chairman; Otis Gouty, of ASCE headquarters; Herbert M. Shilstone, Jr., Convention entertainment committee chairman; and R. M. Collie, general Convention vice chairman.

ASCE Student Chapter Scholarships Available

For the first time the Society is able to offer scholarships to members of ASCE Student Chapters. Four annual awards of $1,000 each—one for each of the Society's four Zones—will be available beginning with the 1962-1963 academic year. The scholarships, which are made possible through a generous bequest of the late Samuel F. Tapman, M. ASCE, were established by the Board of Direction in 1961.

Any Student Chapter may apply for the scholarship without restriction as to academic class or marital status, though he must be a member in good standing at the time of application and award. Not more than three applications may be submitted from the membership of any one Student Chapter. The scholarships will be awarded only to students who will use them to continue their formal education in a recognized educational institution. No candidate who holds any other scholarship or grant will be eligible.

Applications must be submitted, in six copies, to the Executive Secretary of ASCE before March 1, 1962. They must include:

1. Applicant's statement of the reasons believed to justify an award to him.
2. Applicant's plans for continuing his formal education and a statement as to how he will finance his education if an award is granted.
3. Records of academic performance and standing.
4. Appraisals of the applicant in terms of potential for growth, character, capacity for leadership, and interests, from the Student Chapter Faculty Adviser and not less than two other members of the faculty.

Selection—to be made by the Society's Committee on Fellowships, Scholarships, Grants and Bequests—will be based on appraisal of the applicant's justification of the award, his educational plan, his academic performance and standing, potential for development, capacity for leadership, and financial need. Awards will be made by the ASCE Board of Direction on recommendation of the committee, and the successful applicants will be notified of their selection by the Executive Secretary, on or about May 15.

Full details of the award may be obtained from the Faculty Advisers of ASCE Student Chapters.

(More ASCE News on page 78)

Sonic pile-driver shows great promise

A sonic device that applies 400 hp of energy has effected a major advance in pile-driving. This is not the vibratory method developed by the Russians but a more scientific and effective means of transmitting energy to the tip of a pile to drive it rapidly. After a long period of testing and development, the driver is being demonstrated to engineers by setting up a pile driven with the new device alongside of another that is driven with a conventional hammer. The sonic-driven pile moves about 20 times as fast as the other—and relatively much faster where the driving is hard. The sonic unit can be used to pull as well as drive. It pulls as fast as it drives, and has proved quite effective in removing steel sheetpiling.

The sonic driver is based on an invention of Albert G. Bodine, Jr., of Van Nuys, Calif. The C. L. Guild Construction Company, Inc., of Providence, R. I., has obtained exclusive world rights to the pile-driven application and has spent half a million in engineering it to its present state of development. A prototype unit, built in Guild's own shops at Providence, has been in operation for several months. Some 400 piles have been driven to test it in various materials, and it is said to be effective under almost all conditions.

The developers are not giving many details of the sonic unit but it is known to be an eccentric with a variable-speed provision. Weights are so mounted that alternate ones operate in different directions, and are so timed that they are opposed to counteract horizontal forces but combined for vertical effect. Virtually all the 400 hp developed by the driver is said to be delivered at the bottom of the pile. The power is provided by a 500-hp war-surplus gasoline engine, made by Ford for the Sherman tank, the power being transmitted by a hydraulic drive. This power is in contrast to the conventional steam hammer, where the 15,000 ft-lb usually specified for driving is equivalent to only 27 hp.

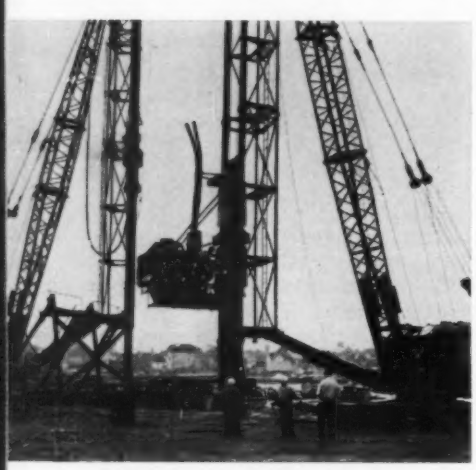
The boring log and driving record for installing a pipe pile of 12¾-in. outside diameter, closed with a flat plate on the bottom, is given in the accompanying tabulation. Driving was done with a No. 1 Vulcan hammer (single acting, with a 5,000-lb ram, 3-ft drop). This driving record is about as would be expected from the number of blows on the test spoon of the sampler. In the same material, the sonic driver put an identical pile down 70 ft in less than a minute. It should be noted that nearly 40 ft of this length was in material that required 25 to 35 blows per foot on the sample spoon.

Guild is building additional hammers, incorporating some new developments. These units will be used first by his own organization and later will become available to others as the method is perfected and the equipment built. Patents cover different parts of the equipment. International patents are being obtained.

The sonic driver operates with an almost total lack of noise and vibration. While the conventional hammer was pounding away on one installation, the sonic unit drove and pulled a similar pipe pile many times. A rigid connection is required to the top of the pile. This was effected on the demonstration unit by bolting to a welded-on flange but a clamping device is available for the driving head so that the sonic vibrations can be transmitted into the pile. In driving, about 11,000 lb of weights are placed on top of the pile to hold the tip down against the soil and force penetration. The machine is operated at about 100 cycles per second (6,000 rpm) but this can be varied up to 150 cycles. Some variation is necessary to accommodate transmittal of the sonic waves, similar to a sine wave, in different materials. (By contrast drivers developed in Europe operate at about one-fourth this frequency.)

An important question that arises when the sonic driver is used is where to stop the pile. In the demonstration, piles went deeply into adequate bearing materials with little slow-down of penetration. It may be that the first use of the driver will be for sheetpile and soldier-beam installation and extraction, and for driving piles to end bearing on known hard strata.

Soil studies and load tests, with accurate recording of driving energy, may soon indicate a way to determine the capacity of the pile as it is driven. Load tests show that piles driven by a conventional hammer and those installed by the sonic driver to the same depth in bearing strata have comparable capacities. But at present the only proof of the bearing capacity of a pile in friction material is a load test or additional test driving with a conventional hammer.



Bodine sonic pile-driver is controlled from the moving platform and the power plant extends 7 ft ahead of the leads. Note conventional hammer at left driving a similar pile.

Boring record and driving log for conventional hammer

Depth, ft	Blows per 6 in. on Sampler		Soil Identification	Blows on Pile
0	23	11	Fill	15
5	1	2		
10	1	2	Organic silt	10
15	4	6		
20	6	7	Fine to coarse sand,	10
25	12	16	medium gravel	19
30	12	21	Fine sand and	30
35	15	23	silt layers	60
40	16	18		200
45	16	20		160
50	15	23	Med. to fine sand,	320
55	13	13	trace of silt	180
60	14	15	Fine sand,	175
65	16	27	trace of silt	100
70	17	29		(Stopped
75	19	30		at 67 ft)

Blows on the sampler are from a 140-lb weight falling 30 in. on a split spoon of 2-in. OD for the second and third 6-in. increment. Blows on the pipe pile, of 12¾-in. OD, are typical per foot for a No. 1 Vulcan hammer. Driving was stopped at 47-ft depth for 24 hours.

Orthotropic-plate construction for short-span bridges

JERRY C. L. CHANG, M. ASCE, Chief Design Engineer, Richardson, Gordon and Associates, Pittsburgh, Pa.

One of the most outstanding advances in bridge design and construction in recent years is the orthotropic-plate floor. A number of bridges with such floors have been built in Europe, especially in Germany, since the Second World War. However, orthotropic-floor construction has been used so far mainly for bridges with spans of 200 ft or over. This is understandable since the dead weight of a bridge becomes the predominate load for bridges of longer span, and one of the main advantages of orthotropic-plate flooring is the tremendous reduction in dead weight as compared with conventional designs. An outstanding example of a modern orthotropic-floor bridge is the Save River Bridge in Belgrad. Here a record span of 856 ft was achieved with plate-girder construction.

A study of short-span bridges

In the past year, the firm of Richardson, Gordon and Associates was engaged by the Reliance Steel Products Company of McKeesport, Pa., to study the feasibility of orthotropic-plate construction for short-span bridges, that is, those with spans of under 100 ft. This is a very important study because of the great number of short-span bridges built each year.

In the beginning, we were somewhat skeptical that an economic justification could be found for orthotropic-plate construction for short-span bridges in spite of the substantial savings that have been realized on long-span bridges. However, further research and analysis of design principles and of fabrication and erection methods have led to the conclusion that orthotropic-plate construction can compete favorably in cost with other types of superstructure, even for short spans.

In addition, there can be savings in the substructure since such a superstructure has only about one-third to one-fifth the weight of conventional construction. Other advantages were also found, as will be discussed later. During our study, we designed two orthotropic-plate bridges—one of 80-ft span and one of 100-ft. The 80-ft design is here presented. Since orthotropic plate is still a relatively new subject, the design specifications and method of analysis are discussed.

Steel plate as a structural member has always been known to the engineer as an effective load-carrying member because of its two-directional properties. However, to achieve full economy in design, it should be stiffened with web members to provide depth. As the moments to be carried are likely to differ in different directions, it is logical to stiffen the plate more in one direction than in another. This leads to an anisotropic plate. If the different web stiffeners are at right angles to each other, then the plate is called an orthogonal anisotropic plate, more generally known as an "orthotropic" plate.

Two types of orthotropic-plate bridge floors in use today, the open section and the closed section, are given in Fig. 1. Since the moment carried in each direction is proportional to the amount of stiffening in that directon, several trial analyses of differently proportioned stiffeners are generally required to achieve a balanced design.

A general rule in the past has been to assume that a bridge is made up of several basically independent elements, such as the deck, the stringers, the floor beams, and the main girders or trusses. Each element is designed to be self-sufficient, that is, each will carry the load from one element to the next without the advantage of any interaction among the various elements. This assumption is of course contrary to fact. Interaction takes place regardless of the assumed simplified method of analysis. However, the amount of the interaction is determined by the strength of the connections. More often than not, the connections are inadequately designed for full interaction.

Concept of structural unity

Orthotropic-plate bridge design fully utilizes the concept of structural unity. For instance, in the short-span bridge here described (Fig. 2), the deck plate is designed to serve in five different ways: (1) as a deck to resist localized wheel loads, (2) as a top flange for the web members spanning the stringers (here called bearing bars), (3) as a top flange for the shallow web members parallel to the stringers (here called cross bars), (4) as a top flange for the longitudinal stringers (together with

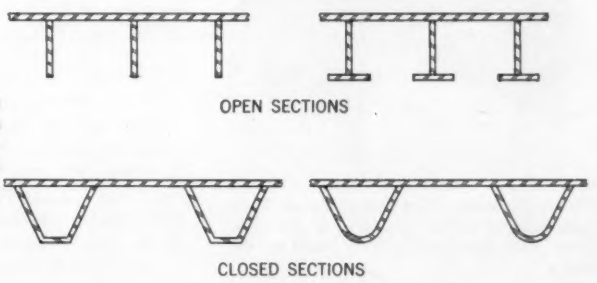


FIG. 1. Plate can be stiffened in various ways. Two types of orthotropic-plate bridge floors in use today are shown.

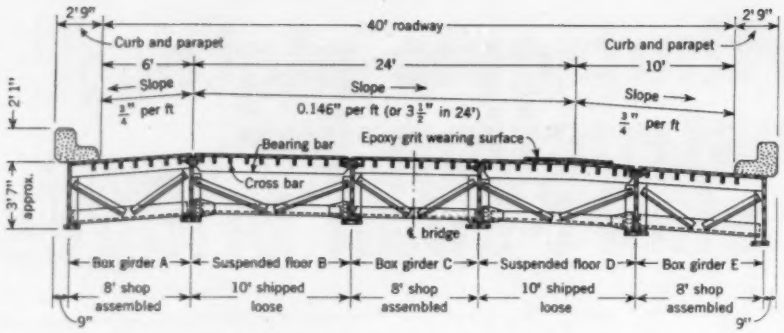


FIG. 2. Cross section shows bridge of 80-ft span designed for orthotropic-plate design.

the cross bars), and (5) as a top chord for the diaphragm bracing system (together with the bearing bars). See Fig. 3. It is to be noted that the bearing bars and the cross bars also serve in a dual capacity. This concept of structural unity is one of the main reasons why much weight is saved in orthotropic-plate design.

A bridge of 80-ft span

At the request of a state highway official, an 80-ft single span was chosen for a complete design. The bridge has two 12-ft lanes and two shoulders, one 6 ft wide and one 10 ft, meeting Interstate Highway Standards for bridge spans of less than 150 ft. The curb and parapet details used are also Interstate standards.

Before the final design was made, much thought was given to the method of fabricating and erecting such a bridge. After many comparative studies, the present scheme was arrived at. The bridge consists basically of three box girders—**A, C** and **E**—and two suspended floors—**B** and **D.** See Fig. 2. The box girders are each 8 ft 0 in. wide from centerline to centerline of web, and approximately 3 ft 7 in. deep. They are completely shop fabricated, including the diaphragm bracings, and each can be shipped in one piece. The suspended floor, 10 ft 0 in. wide, is also completely shop fabricated.

After the box girders have been put in place, erection involves only field bolting of the two suspended decks—and of the bracing members under the decks—to the box girders. High-strength bolts, ⅞ in. round, are used. No field welding is required.

One of the interesting features of the design is the wearing surface. It calls for a coating $\frac{5}{16}$ in. thick, of epoxy resin and grit, which is baked on the floor in the plant. This is a distinct improvement over wearing surfaces that are applied in the field. This wearing surface, which weighs 3 lb per sq ft, is highly resistant to skidding and to salts and water penetration. It is durable and has an excellent bond to the steel. Its light weight further reduces the dead-load stresses in the structure. See Fig. 3.

With the surfacing also prefabricated, it is possible that an orthotropic-plate bridge can be erected and put in service within a couple of days.

The suspended decks and the top flanges of the box girders are of orthotropic-plate construction. The thickness of the deck plate is ⅜ in. and $\frac{7}{16}$ in. for the 8-ft and 10-ft spans respectively. The deck plate is reinforced by bearing and cross bars spaced 12 in. on centers in both directions. This close spacing of bars is used to reduce the magnitude of the localized stress in the plate. The bearing bars are 8½ in. x ¼ in. and 9 in. x ¼ in. for the 8-ft and 10-ft spans respectively. The cross bars are 4 in. x ¼ in. throughout.

Each of the three box girders is made up of two stringers. For reasons of symmetry, only three different designs of stringers are necessary. Throughout, the web is of ⅜-in. plate 41 in. deep, stiffened on one side only. At mid-span the bottom-flange dimensions of the interior stringers are 1⅞ in. x 14 in. and 1⅝ in. x 14 in., and of the exterior stringers, 1⅜ in. x 8 in. The thickness is reduced to ⅝ in. near the ends. Diaphragms are spaced about 20 ft apart on centers.

For maximum economy, the highly stressed deck plate and bearing bars are made of ASTM-A441 steel. However, ASTM-A373 steel is used for cross bars so that the bending rigidity of the orthotropic plate in the two directions is properly proportioned. This results in a balanced design of the orthotropic plate. Because of the limitation on live-load deflection, A373 steel is also used for the stringers. Other details, such as diaphragm bracing and stiffeners, are also of A373 steel. Both these steels are suitable for welding. The total weights of A441 and A373 steel are 86,300 and 72,600 lb respectively, making the total metal weight about 44 lb per sq ft.

Hybrid design, that is, the use of steels of several different strengths in one structure, is bound to become more common in the next few years. Availability of steel in a wide range of strengths, and improvement in welding techniques, have made this possible.

It is quite evident that the whole design of this bridge is rendered practical through welding. The orthotropic floor, which is the chief element of the bridge, simply cannot be feasibly fabricated any other way. Welding also provides for economical fabrication of the box girders.

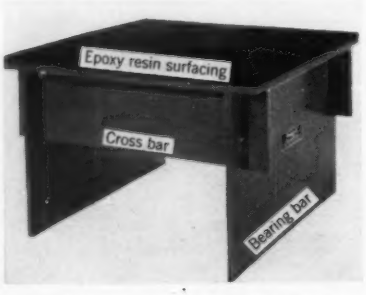


FIG. 3. In sample of orthotropic-plate floor, note wearing surface, baked on in the shop. Cross bars and bearing bars reinforce the deck.

Design specifications and formulas

The AASHO Specifications for Highway Bridges (1957 edition) have been used as the basic guide. For areas not covered by AASHO, the following are used:

1. Localized stress in the deck plate. It should be pointed out here that there is no general agreement among structural engineers as to whether localized stress in the deck plate under wheel loads should be considered. Some claim the plate is many times stronger than the value arrived at from elastic analysis, that high localized stress is of no concern. The writer disagrees with this point of view. It is true that the ultimate strength of the deck plate when subjected to one load application is many times the design condition, based on first-order elastic analysis, since membrane action comes into play as soon as a large distortion occurs when plate is stressed into the plastic range. However, when repeated loads are applied, the plate can fail without being stressed into the plastic range. The argument that any high stress in the plate is very much

localized, and therefore not important, is also not valid since fatigue failure always starts at a point.

To compute localized stress, the writer has developed Eqs. 1 through 4. Their derivation is based on the following assumptions: (1) Poisson's ratio is 0.3; (2) the deck plate is supported by unyielding web members of square spacing; (3) membrane effect is negligible when the plate is not stressed beyond its elastic limit; (4) the plate is continuous in all directions; (5) a wheel load at a uniform pressure of 75 psi over a contact area of 15 in. x 15 in. is assumed, giving a total contact area of 225 sq in. and a load of 16.9 kips.

For support spacing where $a <$ 7.5 in.:

$$-M = -0.054\ qa^2 \quad . \quad . \quad . \quad . (1)$$

$$+M = 0.025\ qa^2 \quad . \quad . \quad . \quad . \quad . (2)$$

For support spacing where 7.5 in. $< a <$ 15 in.:

$$-M = [-0.054 + (a - 7.5)\ 0.0014]\ qa^2 \quad (3)$$

$$+M = [0.025 + (a - 7.5)\ 0.0008]\ qa^2 \quad (4)$$

where

M = bending moment in deck plate, in.-lb.
q = uniform pressure, psi
a = support spacing, in., the same in both directions.

An impact factor of 30 percent must be applied to the stresses computed by the above equations.

2. Primary stress in orthotropic plate acting as a simple slab between girders. One of the reasons why orthotropic-plate design has not spread rapidly to date is the complicated mathematics involved. However, the writer has arrived at some simplified design formulas which readily give the bending moments in the plate.

The well-known plate equation is:

$$Bx\frac{\delta^4 w}{\delta x^4} + 2H\frac{\delta^4 w}{\delta x^2\ \delta y^2} + By\frac{\delta^4 w}{\delta y^4} = q\ (x,y)$$

where

w = deflection of the orthotropic plate
Bx = flexural stiffness per unit section parallel to direction of traffic
By = flexural stiffness per unit section perpendicular to direction of traffic
H = torsional stiffness
q = vertical load on the plate

A more exact analysis of the orthotropic plate would involve partial differential equations of the eighth order.

A study was made as to the range of magnitude of torsional stiffness H of the open-web floor by varying the web spacing as well as the depth. It was concluded that a value of 0.2 can be assigned for H.

With the assistance of three computer programs, we finally arrived at the following much simplified moment formula:

$$M = P\ A\ S^B\ r^C \quad . \quad . \quad . \quad . \quad . \quad . (5)$$

where

M = moment in orthotropic plate, in.-lb per in., or ft-lb per ft
P = one wheel load, lb
S = span, ft
$r = \frac{By}{Bx}$

A, B, and C are constants. See Table I.

It is important to mention that the constants in Table I include multiple-load factors for conditions in which more than one wheel load contributes to the maximum moment in the plate. The wheel spacing is based on H20-S16 loading. Therefore the designer need not concern himself with multiple loads. A Poisson's ratio of 0.3 for the deck plate has also been built into the equation. P is used as 16 kips for the design of the 80-ft span. An impact factor of 30 percent is applied to the stress computed by Eq. 5.

In the initial stage of investigation, it was proposed to make the orthotropic plate continuous transversely over the stringer. After detailed analysis, it was concluded that the negative moment in the continuous plate over the stringer is higher than the maximum positive moment when the slab is simply supported. This led us to the simple-span approach. But another significant advantage is in simplification of erection as it is no longer necessary to field weld the orthotropic floor together longitudinally over the stringers.

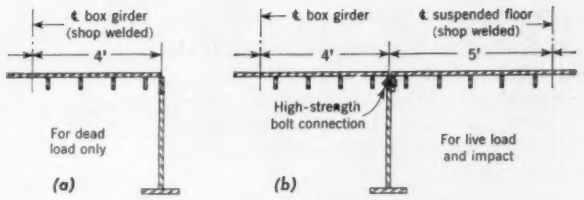


FIG. 4. Typical cross-sections of interior stringer.

3. Primary stress in orthotropic plate acting as top flange of longitudinal stringers. Typical cross sections of an interior stringer are shown in Fig. 4. A distinction must be made between the effective section for dead load, Fig. 4 (*a*), and that of live load and impact, Fig. 4 (*b*). In Fig. 4 (*a*) is shown the interior stringer with top flange on one side only, which is half of the floor of the box section. This half-flange stringer section will have to carry its own dead weight plus the weight of half of the suspended floor. The final section of the interior stringer, after the suspended floor is bolted in place to the box girder, is shown in Fig. 4 (*b*). This full-flange section is then effective for live load and impact. As for the exterior stringer, the half-flange section must carry the dead load as well as the live load and impact.

A large saving in steel is possible through the integrated action of the floor and the stringer. No separate stringer top-flange is necessary. Furthermore, because of the large top-flange area, the neutral axis of the total section is raised, providing a larger overall stiffness.

4. Allowable design stress. AASHO Specifications are used except for the design of the deck plate where the condition of the localized stress is not covered by the present specification. The following two-design criteria were adopted for the deck plate, using A441 steel:

$$\frac{S_L}{40{,}000} + \frac{S_{p1} + S_{p2}}{27{,}000} \leq 1 \quad . \quad . \quad . \quad . (6)$$

$$S_L + S_{p1} + S_{p2} \leq 36{,}000 \text{ psi} \quad . \quad . \quad . \quad . (7)$$

where

S_L = localized stress, psi
S_{p1} = primary stress from floor action, psi

TABLE I. Simple-span moment constants for floor of plate on grid

Based on multiple loads arranged to give maximum moments. See Eq. 5.

	Moment Constants					
	M_x†			M_y‡		
Span Limits*	*A*	*B*	*C*	*A*	*B*	*C*
2'6" to 7'6"	0.120	0.529	—0.166	0.052	0.722	0.386
7'6" to 20'0"	0.120	0.529	—0.166	0.055	0.613	0.353

*For both span limits, r is between 0.04 and 0.4.
†M_x = moment in direction of bearing bar.
‡M_y = moment in direction of cross bar.

S_{ps} = primary stress from stringer action, psi

The value of 40,000 psi in Eq. 6 is based on 80 percent of the yield strength of A441 steel. The value of 36,000 psi in Eq. 7 is based on the zero-to-tension fatigue strength of A441 steel.

Advantages for short-span bridges

1. Saving in substructure. Excluding the weight of the parapet and railing, the dead weight of the superstructure is less than 50 psf. This is about one-third the weight of composite construction consisting of reinforced concrete and steel, and one-fifth the weight of prestressed-concrete construction. Such a tremendous reduction in dead weight should reflect definite savings in the design of bents and abutments of nominal height, say, less than 20 ft. However, for a higher substructure, where horizontal forces such as wind and traction become predominant factors in the foundation design, the reduction in dead load will not be so important.

2. Fast erection of superstructure. As previously mentioned, this bridge can be erected and put in service in a couple of days. The wearing surface has already been applied in the shop. To eliminate any curing period, a precast lightweight concrete parapet and curb are proposed; these can be readily bolted to the floor. Making a bridge available for use quickly can often mean overall savings.

3. Better dynamic stability. With a much lighter dead weight but about the same bending stiffness as a short-span bridge of conventional construction, the orthotropic-plate bridge has a natural frequency of vibration about twice that of a conventional bridge.

The extreme light weight of the superstructure can also mean savings in transportation cost in long-distance hauling.

Other fields of application for the light orthotropic floor are worth mentioning. It could be used to great advantage in movable bridges, weighing platforms, old bridges being rebuilt for increased live-load carrying capacity, and many other structures.

The writer wishes to thank the Reliance Steel Products Company for providing the figures used in this article, and in particular to express his gratitude to Harold Nagin, M. ASCE, the company's vice president, for his many valuable suggestions.

(This paper by Mr. Chang is based on an award-winning manuscript submitted to the Lincoln Arc Welding Foundation in its annual award program for progress in arc-welded design.)

The dramatic shape of the cantilever roof for the Madrid Hippodrome (below) demonstrates both the esthetic and the economic possibilities of thin-shell structures. However, the use of these stuctures has been severely limited by the mathematical difficulties of analysis.

Two principal approaches for overcoming these difficulties have been suggested—model studies and simplified mathematical analyses. To explore these approaches fully, two international meetings were held this summer in Europe: the Symposium on Shell Research in Delft, the Netherlands, and the International Colloquium on Simplified Calculation Methods in Brussels, Belgium.

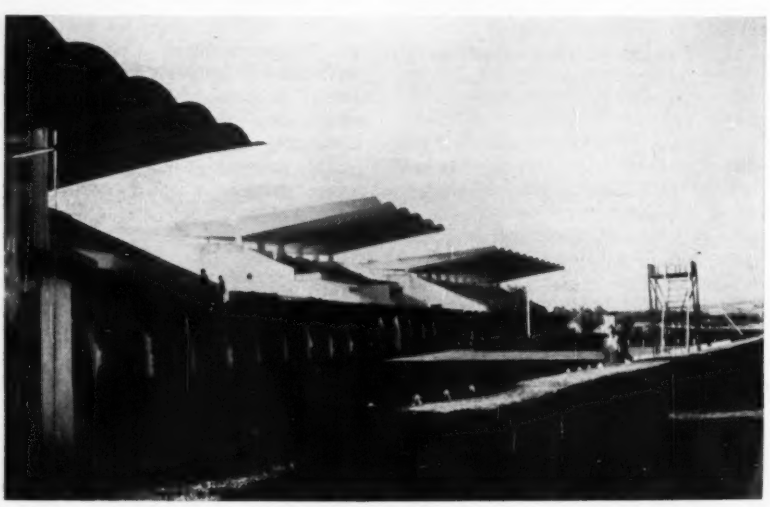
That these meetings were held is due in large measure to the late Prof. Eduardo Torroja, designer of the Madrid Hippodrome and first president of the recently formed (1959) International Association for Shell Structures (I.A.S.S.). The purpose of this report is to summarize briefly the proceedings of these two conferences and to describe certain developments in thin-shell research and design that may be significant for American practice.

Four theories are generally required in a complete analysis of a thin-shell structure. Such analysis was first based on a **membrane theory,** which neglected bending and thus considered only forces in the plane of the shell. For this theory to be valid the shell supports must provide the proper reactions at the shell edges without restraining edge displacements. However, the supports can rarely fulfill the requirements of the membrane theory and bending moments will occur. In some cases the membrane theory provides a reasonable basis for design but often it does not even remotely describe the structural action of a thin shell.

A **bending theory** is necessary but the mathematical difficulties involved are imposing. Bending theories involve strains and are normally based on the theory of elasticity. Such theories are therefore of no value in determining the ultimate load capacity of concrete thin shells, and an **ultimate load theory** is needed. Often shells are so thin that the limiting strength of the materials cannot be reached before instablity occurs. Hence a **buckling theory** is also required. Buckling of thin metal shells has been investigated in detail over the past few years, particularly in connection with aircraft and space-craft design. But for concrete structures little has been done.

DELFT SYMPOSIUM ON SHELL RESEARCH

The Delft symposium was jointly sponsored by the I.A.S.S. and the Réunion International des Laboritoires

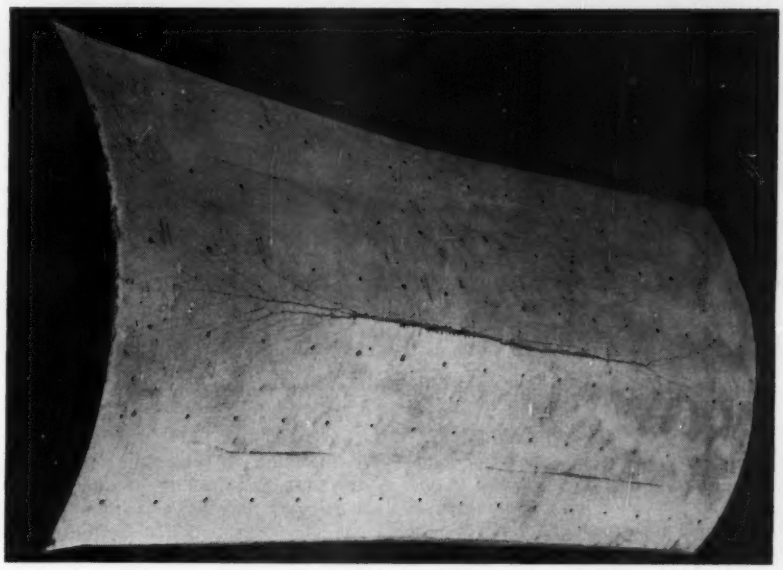


Dramatic shape of cantilever roof for the Madrid Hippodrome again demonstrates the esthetic possibilities of thin-shell structures.

Thin-shell structures

DAVID P. BILLINGTON, A.M. ASCE, Associate Professor of Civil Engineering, Princeton University, Princeton, N.J.

d'Essais et de Recherches sur les Matériaux et les Constructions (R.I.L.E.M.). It could well have been called a Symposium on Model Analysis, since nearly all shell research is based on model tests. Models can be used either to study the validity of a mathematical analysis based on the theory of elasticity (elastic models) or to investigate the behavior of specific structures built of a specific material (reinforced mortar models, for example). Models for either purpose can be designed to study a general theory or to serve as the basis for a specific project. Strictly speaking, the models for specific projects are part of design rather than research. But the results of such studies, when combined with many similar tests, can contribute greatly to the formulation of general theories. About half the papers presented at Delft described model tests made in connection with specific projects. In many cases an analysis of model tests has been accepted in Europe as the basis for a design.



In tests conducted by Professor Bouma of Delft the crack pattern, at overload, of reinforced concrete models of cylindrical barrel shells was studied.

Cylindrical barrels

Both the membrane and the bending theories are well worked out for cylindrical barrels where the cylindrical curve is circular (as for example in ASCE Manual 31, *Design of Cylindrical Concrete Shell Roofs*). Professor Bouma of Delft described tests on a series of 11 single-barreled circular cylindrical shells of equal radius. The variables were span length and arrangement of reinforcement. One shell was prestressed and one was continuous over three supports. The crack pattern at overload was recorded and the yield of reinforcement and collapse modes were studied (above). A limit analysis of such shells may become possible, in the same manner as the yield-line analysis for slabs.

Domes

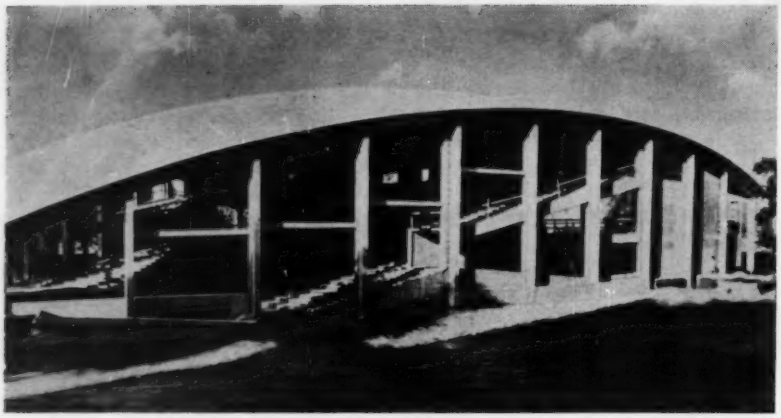
The membrane and bending theories for spherical domes supported on continuous circular walls or footings have been successfully worked out. Attention at this time was focused on the more complicated problems of spherical domes supported only at isolated points and formed by passing vertical planes through the sphere so that the ground plan becomes polygonal instead of circular. For such cases the membrane theory is difficult and a precise bending theory is currently not available to the designer. One such example was described—a plexiglass model study for the concrete dome of the new Hamburg University Auditorium (p. 58), in which the effect of shell prestressing and the buckling safety were studied.

Another type of dome used frequently in Europe is the elliptic paraboloid, generated by translating a parabolic curve over another parabolic curve (Fig. 1). The surface thus formed is similar to a dome of revolution but better adapted to rectangular ground plans. Except at the corners, this shell carries uniform vertical loads primarily by membrane forces. An extremely valuable study of the buckling safety of such shells was carried out by Dr. Schmidt of Leipzig. Unfortunately, Dr. Schmidt and the other seven engineers of East Germany who were registered for the meetings were unable to appear personally, but his paper was presented. It contained the results of tests to buckling on eight aluminum elliptic paraboloids and design recommendations for critical buckling loads. His results compare well with much of the previous theoretical and experimental work, but as Dr. Schmidt indicates in a review of previous work, many past tests have given very different results.

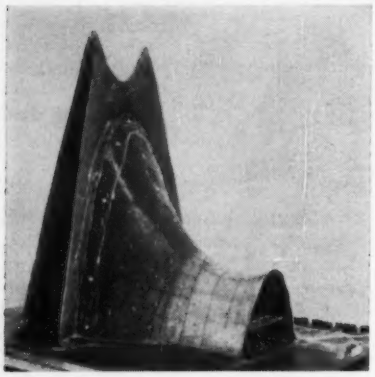
Hyperbolic paraboloids

For hyperbolic paraboloid shells no bending theory is now readily available for design use. In the numerous reports presented on these shells, test results indicated that bending stresses larger than the membrane stresses may exist over large parts of the surface. One report described wind-tunnel tests on hyperbolic paraboloid shells in which unusually large suctions were noted at the high corners. There is perhaps little danger of failure, particularly in concrete shells under wind load, but in many completed shells the roofing and insulation have been sucked off. In metal shells there is the further danger of stress reversals and excessive vibrations.

One English designer, in demonstrating how a consulting engineer may use models in design, recommended fiberglass models for use early in the design stage because of the ease of fabrication even though fiberglass is not a reliable material for research. Such simple models can be invaluable



New auditorium in Hamburg, Germany, has spherical dome with vertically supported edges.



An unusual shell roof for a Polish church is seen in the model. Roof is formed by intersecting doubly-curved surfaces.

as a guide to the structural action of complicated shapes.

A striking example of unusual shell forms was shown by a model for a new church in Poland roofed by intersecting doubly curved surfaces (above).

Conoidal shells, formed by generating a straight line over a curve at one end and a similar but flatter curve at the other, are excellent for north-light roofs. Formwork for conoidal shells can consist of straight pieces.

India is producing shells, described by Dr. Ramaswamy, for housing roofs (p. 59) which are formed by allowing a membrane to drape freely from a flat rectangular frame. Once draped, the membrane has a thin layer of concrete placed over it. When hardened and turned over, this concrete membrane supports its own dead weight by uniform internal compressive stresses.

A similar concept was presented by Professor Harrenstein of the University of Arizona, in which a membrane is inflated and the surface contour measured.

These methods amount to prescribing a boundary condition and finding the membrane that fits for a given load. Theoretically, the bending problem is avoided, and very thin, lightly reinforced concrete shells result. Unfortunately, such surfaces become quite flat, particularly at the corners. Large bending moments occur in the shell and high tensile forces are induced in the edge beams.

Mr. Isler of Switzerland described a series of over fifty such shells built in his country in which the edge beams are post-tensioned to counteract the edge-beam tension and reduce shell bending. He stated that careful model analysis had preceded the design of this type of thin shell.

Model techniques

Careful model analysis is basic to the use of such studies for design. Elastic models require a material with well-defined elastic properties, such as steel, aluminum, or some plastics. Two groups of plastics were mentioned most frequently, Plexiglass and araldite. Plexiglass is a trade name for a methyl methacrylate with good elastic properties. It is produced in flat sheets which can be heated and bent over a mold to form singly curved shells. Doubly curved shells can be formed by applying a vacuum and sucking the flat plate against a curved mold, but the shell thickness is no longer the same as that of the plate. Araldite is an epoxy resin that can be cast into any form and to very close dimensional tolerances. The araldite also has good elastic properties and does not creep as much as Plexiglass.

The elastic models are usually tested by applying loads at a large number of closely spaced points. One major problem is to determine accurately the size and distribution of the load. At the Central Laboratories in Madrid, the load is supplied by metal cylinders, closed at the bottom and filled with weights. The cylinders are floated in a reservoir of water. The water level can be accurately lowered and the load smoothly applied. At the Bergamo Laboratories in Italy, load has been applied by a weighted platform suspended from the many load points by metal hangers, each with an identical link of rubber. Each rubber link elongates the same amount and so applies the same load, even though the total hanger lengths differ greatly from one point on the shell to another. Both these systems of loading avoid the numerous carefully calibrated jacks used in many other laboratories.

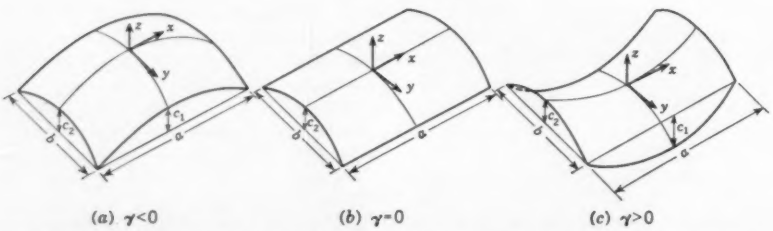


FIG. 1. Elliptic paraboloid is generated by translating a parabolic curve over another parabolic curve ($z = \frac{1}{2} k_2 [rx^2 - y^2]$).

INTERNATIONAL COLLOQUIUM ON SIMPLIFIED CALCULATION METHODS

The goal of the Brussels Colloquium, jointly sponsored by I.A.S.S. and the Association Belge pour l'Etude, l'Essai et l'Emploi des Matériaux (A.B.E.M.), was to simplify the calculation methods as much as possible, consistent with available research data and structural safety. In any research it is vital to work towards a general mathematical theory. Such theories were presented, some derived solely from mathematical studies and others correlated with research work.

Cylindrical barrels

For some time there has been a great interest in simplifying the analysis of long barrel shells by considering the shell as a beam of curved cross-

section. Two reports were presented dealing with this approach and including the results of model tests as confirmation.

An even simpler approach was presented by Mr. Bennett of England, in which the results of over 250 elastic computations and simple direct formulas for the maximum values of all the significant internal forces were presented. Mr. Bennett stated that "the general distribution of these forces is known from past experience and providing the maximum values are known, the distribution of the forces is usually immaterial when detailing the shell." His present method is limited to symmetrical interior barrels with feather-edged valleys or with valley beams and external half barrels with vertically supported edge beams.

It is evident that experienced designers usually find a rapid basis for the design of individual shell projects by relying heavily on some simplified method combined with their previous experience.

With regard to buckling, it was emphasized that non-linearity appears in two ways: first, when the materials become inelastic so that deformations are no longer directly proportional to load, and second, when the deflections become appreciable and thus the geometry changes with changing load.

The only two papers presented on buckling indicated the advanced analytic work currently being done; yet there remains a significant lack of analytic or experimental evidence currently available to the designer of large thin-shell structures.

Domes

To stimulate discussions, Colloquium papers were sent to all registrants before the meetings. General reports were included in which leading authorities summed up all the papers on one subject. Professor Zerna of West Germany prepared such a report, "General Methods Available for All Kinds of Shells and Methods Available for Surfaces of Arbitrary Shape." He divided thin shells into three classes: (1) shells with zero Gaussian curvature which are singly curved, such as cylinders or conoids (Fig. 1*b*); (2) shells of negative Gaussian curvature which are doubly curved with the curvatures oppositely directed, such as hyperbolic paraboloids (Fig. 1*c*); and (3) shells of positive Gaussian curvature which are also doubly curved, but the curvatures are in the same direction, such as domes (Fig. 1*a*).

Professor Zerna pointed out that only in the last case can a very simple solution be obtained for the bending theory. This solution, which usually amounts to considering the free edge of a dome as the free edge of an equivalent full cylinder, does not work unless the dome is continuously supported along a level circular base. Some simplified bending theories were presented for domes on polygonal bases, such as the Hamburg dome (p. 58).

Free shell, here used to roof a structure built in India, was formed by allowing a flexible membrane to drape freely over a flat rectangular frame. A thin layer of concrete was then placed over the membrane and cured. When turned over, this concrete membrane supports its own dead weight solely by internal compressive stresses.

Hyperbolic paraboloids

No greatly simplified design procedure was presented for the bending or buckling of hyperbolic paraboloids. Dr. Apeland and Professor Popov of the University of California presented an analysis of bending stresses in translational shells (Fig. 1). These include elliptic paraboloids, parabolic cylinders, and hyperbolic paraboloids. The great value of this contribution is that the results can be tabulated and a solution provided for the two doubly-curved cases in the same form as that already available for cylindrical barrels. The authors stated that these tables will be published soon.

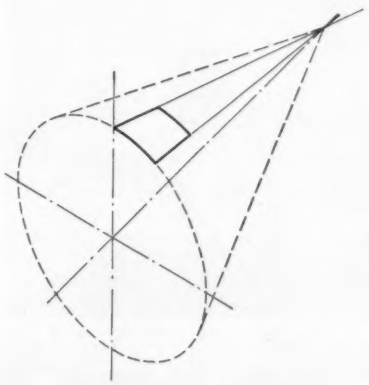


FIG. 2. Fustrum of a cone.

Other types of shells

One question frequently facing the engineer is how to analyze a shell, the form of which varies slightly, from one that has been fully analyzed previously. Intuitively the designer may feel that the differences will be slight but this may not always be so. Dr. S. Medwadowski of San Francisco tackled this problem for the special case of bending in a conical frustrum segment (Fig. 2). He showed that an equivalent curvature can be approximated and the segment analyzed in a relatively simple way, similar to that for a cylindrical barrel shell.

Such imaginative approximations, combined with model studies, present the experienced engineer with the means of designing a wide variety of thin shells. These two international meetings, focused on the future, could have no better symbol of the great possibilities for thin-shell structures than the stunning cantilever roof outside Madrid, which Don Eduardo created out of his own studies with models and simplified calculation methods —in 1935 (p. 56).

Water resource and pollution control legislation

SAMUEL A. GREELEY, Hon. M. ASCE, Partner, Greeley & Hansen, Chicago, Ill.

During the decade of the 1950's, and particularly in the latter half of it, there was great legislative activity in the fields of water resources and water pollution control. These activities, extending from the local to the federal level, embraced such matters as regulation, financing, research, and planning—as well as some promotional effort directed to informing the public and eliciting its support. The trend has been toward more federal participation, management, control and financing.

The increasing need for water with the increase in population and expansion of industry is decreasing the gap between the available supply and the need. Natural water resources are abused through neglect, waste, and uncontrolled pollution. The dwindling margin between supply and demand has brought to the fore a vital need for stronger management and development, and for more research than has been evidenced at local and state levels. The result is the extensive activities of recent years at the federal level.

As management and control move from local to federal levels, it becomes more difficult to be a good citizen, in so far as some measure of participation is concerned. Nevertheless, the authority of the Federal Government is now effective and will probably increase. Citizens, therefore, and especially those educated and experienced in water and sewage works, should accept an increased responsibility in seeking fair, realistic, and economical administration of such activities.

Fundamental considerations and realistic objectives

For an understanding and appraisal of recent legislation some fundamental considerations must be recognized. In water resources, consideration must be given to a fair balance between need without waste and competing uses of water with due regard for reasonable and proper expenditures.

In water pollution control, fundamental considerations require a firm and acceptable establishment of real need and fair financing.

It has been said that our future prosperity depends on a knowledge of our water problems and on proper action to preserve and make use of our natural water resources. This is of course true, but other basic handicaps must be overcome if the nation is to prosper. A study of water legislation should recognize such general aspects as the cold war, the national debt, obligations to other peoples, and the standard of living.

Of course sufficiently pure water in sufficient quantity must be provided. But these objectives must be stated in relative terms because no single standard can be applied to all waterways as regards use, need and development. The original purity cannot be maintained everywhere except at exorbitant cost. Realistic objectives of water legislation should be understood by the citizenry.

Standards of water quality and waterway cleanness are necessary. These must provide safe, sufficient and satisfactory water for life, health, recreation, industry and commerce. The U. S. Public Health Service has published standards of quality for the water used for domestic and industrial purposes. Many standards for the cleanness of waterways have been set up by states and local authorities, but there is need for clarification of this important matter with due regard to the multiple kinds of waterways and water uses.

Federal powers and laws

Recent legislative activities at the federal level are illustrated by the work of the Kerr Committee on water resources, of the Public Health Service and of several other committees of Congress on pollution control.

The records of hearings and the publications of the Kerr Committee are very useful and competent. The final report included a recommendation that the Federal Government should stimulate the states, and should provide a minimum of $5,000,000 annually to be matched by the states, for use in preparing long-range plans for water resources development.

Print No. 29 of the Kerr Committee, "Water Requirements for Pollution Abatement," is also thought provoking. It includes a competent report by George W. Reid, a professor at the University of Oklahoma. The fundamental considerations there given for pollution abatement can be summarized as follows:

1. Dilution
2. Long-flow augmentation
3. Lagoon storage during critical periods
4. Supertreatment of wastes
5. Tolerance for departures from standards during short and infrequent periods

As regards pollution control, the records of many hearings such as those relating to the Federal Water Pollution Control Act, the Delaware River Compact, the Kerr Committee and others are useful and competent. The result has been the introduction of several bills to expand and strengthen federal participation. Not all these bills were passed by the recent Congress. References to them and their status appear in following paragraphs.

The activities of the recent Congress as to water resources and pollution are shown by the following brief descriptions of the more important laws or acts introduced, some of which passed while others did not.

Public Law 87-88. This is known as the Federal Water Pollution Control Act. It amends Public Law 660 which amended Public Law 845. It vests much authority in the Secretary of Health, Education and Welfare. The new law greatly increases federal funds for the implementation of the law and for "Grants for Construction." An important new item is that the Engineer Corps, the Bureau of Reclamation and other federal agencies must include capacities to provide wa-

ter releases for the purpose of water quality control, except that any such releases shall not be a substitute for adequate treatment. Note should be made of the word "adequate." Reference should be made to H.R. 4036 and to H.R. 6441.

The Secretary is authorized to make grants for necessary treatment works to prevent the discharge of "inadequately" treated sewage. The impact of the words "adequate" and "inadequate" will depend very much on the required standards of cleanness for the receiving waterway. Enforcement measures are provided for interstate and navigable waters and also for intra-state waters if requested by the governor of a state. This law was passed and signed by the President.

Senate Bill 1629. This bill is pending and has not become law. It is referred to as the Water Resources Planning Act of 1961. It authorizes appropriations of $5,000,000 per year for the next ten years for grants to the states to assist them in developing comprehensive water resources plans. In general, it implements a recommendation of the final report of the Kerr Committee. Reference should also be made to H.R. 487.

Senate Bill 1475. This bill is pending and has not become law. It comprises an amendment to Public Law 87-88 by authorizing the regulation of stream flows to permit releases for the control of water pollution. To some extent this provision is included in Public Law 87-88.

Senate Bill 1778. This bill is pending and has not become law. It is similar to Senate Bill 1629 and is referred to as the Public Works Planning Act of 1961. Like Senate Bill 1629, it will implement a recommendation of the Kerr Committee.

Senate Bill 1746. This bill, which also is pending and has not become law, is referred to as a Great Lakes Basin Compact. It provides for a comprehensive development, use, and conservation of the water resources of the Great Lakes Basin, including the St. Clair and St. Lawrence Rivers. The Provinces of Ontario and of Quebec may become parties to the compact if they so desire. A commission is provided which shall include a federal representative to serve with a per diem compensation not to exceed $15,000 per calendar year. H. R. 5810, not yet passed, provides Congressional consent to the Great Lakes Basin Compact.

H. R. 4036. Reference should also be made to this bill, sometimes referred to as the Blatnick Bill, and to H. R. 6441, which is H. R. 4036 amended after consultation with the Senate. These two are in the nature of proceedings relating to Public Law 87-88. The reports of the hearings on these two bills contain much interesting and useful opinion and information.

Two other matters relating to federal legislation should be included for reference. The first is Public Law 85-500, designated as the Water Supply Act of 1958. The other item is two pending bills, one H.R. 8177 and the other S. 2246, both intended to accomplish the present Administration's water program. These two bills are pending and have not yet been voted on.

Sewage and waste treatment plant at Austin, Minn., is of special interest because of the large proportion of industrial waste it receives from the Hormel packing plant. This municipal plant, financed by general bonds, includes anaerobic treatment for the packing-house waste. The effluent from this is mixed with the municipal sewage for final treatment. Hormel makes a sizable contribution to annual costs.

Community Facility Administration. There has been, recently, a considerable use by municipalities of this Administration for water and sewage works financing. This activity is based on Public Law 87-70, dated June 30, 1961, which supplements earlier laws and describes a comprehensive document compiled by Representative Gilman G. Udell as "Home Owners Loan Acts and Housing Acts." Funds for Public Facility Loans for specific projects have been increased from $150,000,000 to $650,000,000, and funds for Public Works Planning have been increased by somewhat over $20,-

Water treatment plant at Barranquilla, Colombia, represents advanced procedure by a South American city, and is pointed out to tourists with pride. It has been in operation for some 25 years, with additions from time to time.

District of Columbia plant provides complete sewage treatment. Additions to the original sedimentation and sludge-digestion plant have provided sludge-disposal facilities and secondary-treatment works. Recent construction of sludge-handling facilities is soon to be supplemented by an addition to the secondary treatment plant.

000,000. The bill is before the Senate Committee on the Judiciary and the House Committee on Foreign Affairs.

Civil works program of Corps of Engineers. In addition to the foregoing, the recent Congress has appropriated $966,443,880 for the civil works program of the Army Engineers. This is described as a new "all-time high." The appropriation is for the following categories:

General investigations	$15,877,000
Construction, general	724,021,880
Operation and maintenance, general	138,397,000
General expenses	13,148,000
Flood control, Mississippi River and tributaries	72,950,000
Navigation Congresses meeting	30,000
St. Lawrence Board	20,000
Permanent appropriations	2,000,000
Total	$966,443,880

Delaware Basin Compact. At the federal level is the Delaware River Basin Compact. For the first time, the Federal Government will participate with other states in the active administration of a water compact and will contribute to current expense budgets. The Delaware Basin Commission must prepare a Comprehensive Plan and an annual Water Resources Program with reference to: water supply, pollution control, flood protection, watershed management, recreation, and hydroelectric power.

The Commission may build and borrow, therefore, and the bonds shall be "direct and general obligation bonds of the Commission," which are to be serviced by revenues without recourse to taxation.

In Article 5, Pollution Control of the Compact, Section 5.2 relates to "Policy and Standards." The Commission is given power to control future pollution and to abate existing pollution. The standard of such control shall be that pollution by sewage or industrial waste shall not injuriously affect waters of the basin as contemplated by the Comprehensive Plan. The requirement of a standard is a good procedure and the determination by the Commission of the extent to which pollution will injuriously affect the waters of the basin is, in my opinion, proper latitude.

The so-called Compact is Public Law 87-328 and is excellently written. The Compact is to endure for 100 years. There are references to the out-of-basin diversion to New York City during this life under the present Supreme Court Decree.

The legislative program of recent years includes the Great Lakes-Illinois River basins project which is probably the largest comprehensive, nationally sponsored study of water supply and pollution abatement problems. Congress appropriated $500,000 in September 1960 to inaugurate the work. That going on now is to be expanded, with the approval of Congress, to a six-year program and an estimated total expenditure of $12,000,000. All the aspects of water quantity, quality, and pollution abatement will be included with the general objective of preparing an overall comprehensive plan for the management and development of the waters of the Great Lakes and the Illinois River.

State powers and acts

During the decade, and especially recently, much attention has been given to water resources and pollution matters by state legislatures. One of the most stimulating is the Watershed District Bill prepared and sponsored by the Ohio Water Commission and introduced into the last Ohio legislature. The original draft of the bill was competent and useful in its general concept. Among the good features were:

1. The Ohio Water Commission was given power to organize a watershed district by petition to a court of common pleas.
2. Advance funds could be obtained by application to the Water Commission.
3. A procedure was established for accomplishing a Comprehensive Program and Plan.

In my opinion the financing procedures were too complicated and made it somewhat difficult to provide a fair method. The bill as passed required approval of the voters for the establishment of a District and made no provision for construction work or funds.

The great California Water Plan for transferring water from the northern to the southern part of the state at an estimated cost of some $1,750,000,000 is one of the great examples of state enterprise as compared to a federal undertaking.

Local acts and ordinances

During the past few years there has been an unusual and perhaps somewhat unrecognized activity by local municipalities in organizing water and sewer authorities and sanitary districts. A number of these provide for the organization of metropolitan areas considerably larger than the principal municipality. Among such activities are the bills to create metropolitan sanitary districts or authorities for Minneapolis-St. Paul, St. Louis, Mo., and Denver, Colo.

The Virginia Water and Sewer Authority Acts, which permit activity at the municipal level, should also be listed. In such organizations and in the enabling acts on which they are based, it is important to include the

method of organization, provisions for annexations, and provisions for financing. There are too many variations between the different acts and ordinances to permit abstracting them in a brief article. Varying local conditions may well require such differences, but there is also an element of a non-application of broad experience.

Also, existing acts are being amended to a considerable extent. This again suggests that improved approaches and procedures for the original wording of such acts might be very advantageous.

Reference should be made to the trend toward the development of suburban areas and the resulting need for metropolitan administration. This is illustrated by the favorable action of the Dade County, Fla., voters on a proposition to retain the strong central government which to some extent supersedes the operations of municipalities in that county.

Interstate compacts

It is pertinent to refer again to the Delaware River Basin Compact as a competent and important document and one likely to stimulate the organization of watershed or river basin districts. On this important aspect of recent water resource and pollution control legislation, reference should be made to Senate Bill 1746 to provide a Great Lakes Basin Compact.

An able review of the status of the Potomac River Sanitation Compact is contained in "Potomac Prospect," dated January 1961, by a coordinating committee of which Dr. Ira N. Gabrielson was chairman.

Recent court decisions

The final test of legislation comes through court review and decision. Under Public Law 660, the U. S. Public Health Service has instituted a number of enforcement actions related to interstate and navigable waters. Under the new legislation, such actions can be instituted with regard to intrastate waters if the governor of the affected state so requests.

The enforcement action most frequently referred to is that undertaken in June 1957, against St. Joseph, Mo., together with its 18 associated industries. This case was only recently removed from adjudication by the authorization of a $6,000,000 bond issue to build sewage treatment works.

An important outcome of such court cases will be a realistic understanding of the need for the construction of works to remove pollution and the degree of treatment required for an acceptable standard of cleanness. A good article on this kind of court action appeared in *Engineering News-Record* for April 20, 1961.

Financing aspects

It is essential that the financing of water supply and pollution abatement projects be fair. One aspect is that contributions or payments to the needed total annual revenue should be made by the properties and persons (or users) for whose need the project is built, approximately in proportion to the extent to which they cause expenditures to be made. Thus persons using the project on the one hand, and property on the other, would each contribute to the total annual revenue needed for operation, maintenance, and debt service in proportion to the amount each causes to be spent.

The Illinois River Conservancy District Act of 1925, and the recent amendment, require that all needed moneys be derived from taxes or special assessments. The formation of Conservancy Districts has been voted on twice and in each case has been defeated. It is suggested that this was because the voters considered the tax or assessment methods of financing unfair. For instance, properties remote from the waterway would find that the usefulness of the project would be relatively less than the resulting difference in assessed valuation.

In the long run, the costs of water supply and pollution control works are paid by the following sections of society: (1) general users and those directly benefited by use, (2) special users such as industries needing water and discharging polluting wastes, (3) local property owners, and (4) federal taxpayers.

Techniques and procedures are now available for estimating that part of the project cost each of these four groups causes to be spent. A national or state need is satisfied by parts of some projects. This part or share would be paid by a federal or state grant.

Questions relating to the use of grants or subsidies as proper financing aids will depend greatly on local conditions and very likely will never be fully and convincingly resolved. Assuming that in the long run needs are real and financing is fair, there will be exceptions where the burden of the cost of financing water development and pollution abatement projects is unusually high so as possibly to become prohibitive. In some cases, research is necessary to reach an acceptable and economical solution. Where others beside local citizens and officials have an interest in such cases, assistance through grants or subsidies will be justified. It has been proposed, for instance, that Congress should provide stepped-up incentives and that provisions should be considered to assist industry by provisions for fast tax amortization deductions. Such measures are pertinent for localities where special conditions occur.

In the application and use of recent laws and acts, industrial needs for water and for the treatment of wastes will be a considerable factor in some cases. A fair allocation of the costs will, in my opinion, be more likely to bring support from citizens and industrial groups than an arrangement whereby an unfair share is carried by one or two major users or properties.

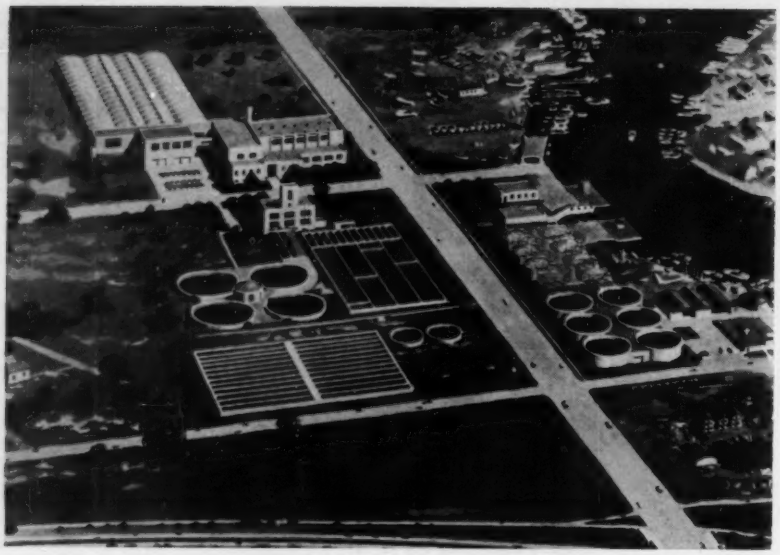
This consideration has even greater weight in the case of industrial wastes that are more readily treated when mixed with domestic sewage in municipal or district treatment plants than by themselves. In such cases and in general, there should be no objection on financing grounds, if fair charges are made.

British practice

In Great Britain these problems have been pressing for many years. An amendment to the Rivers (Prevention of Pollution) Bill of 1951 came into effect on September 27, 1961. The Act makes it unlawful, after a date set by the Minister of Housing and Local Government, to discharge sewage or trade effluents into a stream without the approval of a River Board. The purpose of the Act and of the 1961 amendment is to "maintain or restore the wholesomeness of the rivers and other inland or coastal waters of England and Wales."

A very competent book on this subject has been published in Great Britain, entitled *Aspects of River Pollution*, by Louis Klein, Chief Chemist of the Mersey River Board. A quotation from Chapter 14, "Standards for Rivers, Sewage Effluents and Trade Effluents," is pertinent to this subject:

"Before making by-laws, a river board must carry out a thorough survey of the river or rivers for which standards are required. Data needed for this purpose would have to include flow measurements and analyses of the stream at a number of points and information on the volumes and character of all sewage effluents and trade effluents discharging to the stream. A decision would have to be made on the quality of water needed in the river, or in different parts of the same river and, in this connection much would depend, to use the words in Section 5 of the Act, on 'the extent



Coney Island Sewage Treatment Plant is one of several plants required by the City of New York, N.Y. Of interest are the covered aeration tanks with barrel-type roofs at far left.

to which the stream is or may in the future be used for industrial purposes, fisheries, water supply, agriculture, transport or navigation.'"

Canadian practice

A most complete and successful piece of legislation is the Water Resources Act of Ontario, Canada. The Act, as amended, is Chapter 281 of the Revised Statute of Ontario, 1960. It creates a Commission with power (Section 16):

"(*a*) to control and regulate the collection, production, treatment, storage, transmission, distribution, and use of water for public purposes and to make orders with respect thereto;

"(*b*) to construct, acquire, provide, operate, and maintain water works and to develop and make available supplies of water to municipalities and persons;

"(*c*) to construct, acquire, provide, operate, and maintain sewage works and to receive, treat, and dispose of sewage delivered by municipalities and persons;

"(*d*) to make agreements with any one or more municipalities or persons with respect to a supply of water or the reception, treatment, and disposal of sewage;

"(*e*) to conduct research programs and to prepare statistics for its purposes; and

"(*f*) to perform such functions or discharge such duties as may be assigned to it from time to time by the Lieutenant Governor in Council. 1957, c. 88, s. 16."

Every aspect of the water problem seems to be included. The operations of the Commission, under its competent general manager, Dr. Albert E. Berry, are well described in *Engineering News-Record* of October 5, 1961. Two statements from this are pertinent:

"Two of the world's biggest water problems are to maintain the quality of the water we have and to distribute it where it is needed."

"The relationship between pollution control and water resources development is so strong that they can only be worked together."

Much progress has been made by the Commission under the Ontario Act.

Research

During the hearings and discussions on many of the bills pending or passed by the recent Congress, the need for research was stressed. Public Law 87-88, the Federal Water Pollution Control Act, requires research under the direction of the Secretary of H.E.W. as follows:

"In carrying out the provisions of this section of the act, the Secretary shall develop and demonstrate including basic and applied research, the following:

"(*A*) Practicable means of treating municipal sewage and other waterborne wastes to remove the maximum possible amounts . . . of pollutants to restore and maintain . . . the nation's water at a quality suitable for repeated re-use.

"(*B*) Improve methods . . . to measure the effects of pollutants on water uses. . . .

"(*C*) Methods for evaluating the effects on water quality and water uses of augmented stream flows to control water pollution not susceptible to other means of abatement."

It is suggested that in paragraph (*C*) above (as well as elsewhere) the word "economical" might be inserted before the word "susceptible," although it is probably inferred.

Summary statement

From the foregoing, it is clear that federal interest and financing is quite completely established in recent legislation. It is likely that further steps in this direction will be taken in the near future. The matter of concern at this time is the administration and application of such laws including, in particular, the present Public Law 87-88. This will need thoughtful, competent, experienced, and responsible direction. Progress in the effort to develop an adequate supply of water of good quality is further implemented by state and local enabling acts to promote and permit works for water supply and for pollution abatement. Questions as to the use of grants or subsidies and as to the relation between the roles of federal, state, and local agencies are matters of great concern, which have been determined by recent legislation in the direction of federal action. An example of administration largely of the federal or state type is that of the Province of Ontario, Canada, which is moving ahead competently and efficiently.

It seems proper to keep in mind fundamental considerations as points of departure for the successful application and administration of acts for controlling and financing water supply and pollution abatement projects. Among such fundamental considerations, the following are suggested as pertinent, practical, and essential:

1. Solutions to water supply and pollution abatement problems will receive public support if a realistic need is established and if fair methods of financing are used.
2. Standards of water quality must be more or less uniform and absolute, but standards of waterway cleanness should be applied to the characteristics and uses of each waterway.
3. In the administration of laws and acts intended to resolve the increasingly pressing water supply and pollution abatement needs, realistic appraisals of waterway uses and a reasonable regard for overall economy are essential.

Cast-in-place concrete pipe cuts time and costs

ERNEST C. FORTIER, F. ASCE, Consulting Engineer, Fresno, Calif.

The monolithic pipe here described is of unreinforced concrete, cast in place in the trench, using the semicircular shaped bottom and vertical sides for the outside form for the lower part of the pipe. During placement, the upper part of the pipe is supported by steel or aluminum forms or by an inflated rubber tube.

In the initial stage of development of cast-in-place pipe in the San Joaquin Valley of California, the pipe was placed in two operations. After the concrete in the bottom half of the pipe was placed and shaped with a machine or "boat," semicircular metal forms were positioned to support the upper half. Wooden struts bearing against a board placed on the fresh concrete on the bottom held the upper forms in position. To obtain a satisfactory bond at the horizontal joint, it is necessary for the joint surface to be clean and still plastic. The two-stage process was improved by the use of one machine to place the bottom half and a separate machine to complete the top.

Essentially a traveling slip-form

To avoid the horizontal construction joint and to improve the method of placing and consolidating the concrete, a machine has been devised to place the whole pipe in one operation. This is known as the No-Joint process. The machine is in essence a traveling slip-form which closely fits the sides and semicircular bottom of the excavated trench. A gasoline engine mounted on the machine provides power for the operation of an electric generator and a variable-speed winch so that the machine can travel along the trench bottom. Electric power actuates two high-speed Syntron vibrators attached to the bottom of the inside form, a submersion or "spud" type vibrator attached to the hopper, and a spading mechanism mounted on each side of the hopper which moves the concrete down and around the form. The vibrators then consolidate and compact the concrete.

World-wide interest shown

Over the past ten years the Fullerform Continuous Pipe Corp., of Phoenix, Ariz., has developed a method of forming a completed pipeline in one operation by the use of an inflated inner form of rubber and fabric. An electric generator driven by a gasoline engine mounted on the machine furnishes electric power to a tamping device, a vibrator and a winch that pulls the slipform along the bottom of the trench. This process, developed in Arizona, has recently been used in California on a state highway job. Equipment is available for pipe sizes from 12 to 60 in. in diameter. Diameters smaller than 24 in. are feasible because it is not necessary for workmen to enter the pipe to remove forms.

Expansion or contraction joints are not generally employed in any of the cast-in-place processes. For this type of pipe the objective has been an integrally whole monolith, cast in place.

The considerable interest in this rapidly expanding development is illustrated by the world-wide response to recent advertisements in engineering periodicals for cast-in-place pipe. As an example, a brief item of two sentences in the Catalog Digests section of CIVIL ENGINEERING brought 187 inquiries from civil engineers, contractors, university professors, exporters and others representing 30 foreign countries and 33 states of the United States. Foreign inquiries came from Europe, the Near East, Asia, Africa, South America, Australia, New Zealand, the Philippines, and so on. An advertisement by the same company in another engineering journal prompted 343 inquiries from across the United States and from many foreign countries. Interest in foreign lands is crystallizing in actual construction in the Union of South Africa. Engineering and contracting interests in India, Mexico, Venezuela, Japan and Canada are considering monolithic concrete pipelines for irrigation and for sanitary and storm sewers. The government of Australia has shown interest in cast-in-place pipe for its large Snowy Mountain Project.

Recent jobs in which cast-in-place pipe was either specified, or permitted as an alternative, include sizes from 30

As a consultant to the No-Joint Concrete Pipe Company of Yuba City, Calif., from time to time while the process was being developed, the writer was impressed with the explosive growth of the cast-in-place pipe industry. Low cost has undoubtedly provided the main attraction. It is well to bear in mind, however, that no one type of conduit is the best answer for all jobs. Where conditions are favorable for its use, cast-in-place pipe fills a long-felt need for a low-priced conduit. The selection of the type of pipe, however, as well as the design of the system into which it is incorporated, should be based on sound engineering and economic considerations.

A No-Joint concrete pipe, of 48-in. diameter, for a storm-water drain, was installed in Sacramento, Calif., for $8.65 per ft including trenching, materials, construction of pipe and backfilling.

in. to 48 in. with lengths up to 882,000 ft constructed under P.L. 984, under the control of the U. S. Bureau of Reclamation for the South San Joaquin District in California. The California State Division of Highways has used cast-in-place pipe in sizes up to 72 in. Storm drains in cities and flood control districts throughout the West and Midwest have utilized monolithic pipe.

One of the largest installations for irrigation is on the Salt River Project in Arizona. This project is systematically replacing its open laterals with cast-in-place pipe. To date about 60 miles of such pipe has been installed and the ultimate program is for 1,500 miles in diameters from 30 to 54 in.

Initially the common diameters for this type of pipe were 24, 30 and 36 in. In the single-stage No-Joint process, machines are available for casting pipe in diameters from 24 to 72 in. in 6-in. increments. All types except Fullerform have been limited to a minimum diameter of 24 in.

Adjustment of the wall thickness to meet varying conditions is relatively simple in most cast-in-place processes. Thicknesses most commonly used for the various sizes are, in inches:

I. D.	Wall Thickness	I. D.	Wall Thickness
12*	2	42	4
18*	2½	48	5
24	2½	54	5½
30	3	60	6
36	3½	72	7

*Fullerform only.

Concrete quality

Concrete quality in cast-in-place pipe is influenced by the method of placement and consolidation and, as in all concrete, by the quality of the aggregates and the water-cement ratio. Some processes require a higher percentage of sand and a higher water-cement ratio than others.

In the No-Joint process, placement operations are actually facilitated by using a well-designed mix with a slump of 1½ to 2 in. On one job where good aggregates were available, some cylinders exceeded 5,000 psi at 28 days, and 7-day cylinders consistently broke at or near 3,000 psi. Regardless of the method of placement, cast-in-place pipe has shown ability to support external loads and has a good record in freedom from failures due to this cause. The narrow trench (the outside diameter of the pipe) and the excellent bedding account largely for this success.

Load tests have been conducted on No-Joint concrete pipe by the Salt River Project, Arizona, the No-Joint Concrete Pipe Co., the City of San Diego, Calif., and others. The Salt River Project reports a test of an 8-ft section of No-Joint (119 days after placing, no curing). The load test and the pipe saddles were patterned after the ASTM sand-bearing-test equipment. The test was modified in that a sand bed was not placed under the pipe. Actual field conditions were used for the pipe support, that is, the excavated, formed earth ditch. A 4-ft bearing block was placed centrally so that 2 ft of pipe extended on each side. The pipe was covered with 1 ft of compacted backfill. A load of 64,888 lb was required to produce a crack 0.01 in. wide. The compressive strength of the concrete used in the section averaged 2,450 psi for the 7-day tests and 3,950 psi for the 28-day tests.

TABLE I. Test results on No-Joint pipe

Diameter, in.	Load per lin. ft, lb	Equivalent Height of Fill
24	6,352	No limit
30	10,750	No limit
60	14,254	Over 60 ft
120*	25,090	23.4 ft

*This test was on a 4-ft section simulating a typical No-Joint pipe in cross-section form, manner of excavation, mix design and method of placing and consolidating the concrete by vibration.

Similar tests of No-Joint pipe were made at Yuba City and Fresno, Calif., under the direction of the writer. In these tests, the load was applied directly to a 4-ft section of pipe through a standard ASTM sand box. The results of these tests, without any cracking, are shown in Table I. The equivalent height of fill above the top of pipe is based on saturated top-soil weighing 110 lb per cu ft and is computed by the Marston formula assuming standard trench widths for this type of pipe.

Following these tests a structural analysis was made by the writer to translate the test loads into fiber stress in the shell of the pipe. Bending moments were computed for a vertical external load from earth and live loads, for the weight of the pipe shell, and for the weight of water for a full pipe. Stress coefficients were taken from an article by James M. Paris in *Engineering News-Record* (1921, vol. 87, no. 19).

Similar calculations were made by the Salt River Project for earth and live loads on cast-in-place pipe with 24 in. of cover. The live load considered by the Salt River Project was based on AASHO H-20 loading with an impact factor of 2.0. The earth load was computed again by using the Marston formula, with an earth weight of 110 lb per cu ft. Side support was assumed at ⅓ of the vertical load based on the stress analysis of the test results. The outer fibre stress in the bottom of the pipe shell (point of maximum moment) for various load conditions was determined to be as shown in Table II.

Tests show strength relationships

From the results of hundreds of flexural and compressive-strength tests reported by the Portland Cement Association, the relationship between the two was found to be approximately as follows:

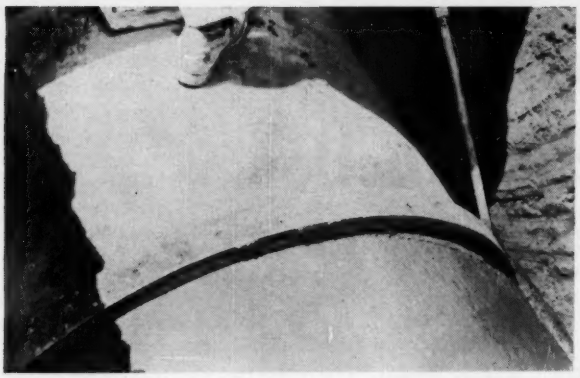
Range of Compressive Strength, psi	Range of Flexural Strength, psi
5,000 to 6,800	625 to 755
4,000 to 5,225	560 to 680
3,225 to 4,300	500 to 620

As a result of the structural analysis made by the Salt River Project and the excellent experience record of extensive quantities of cast-in-place pipe

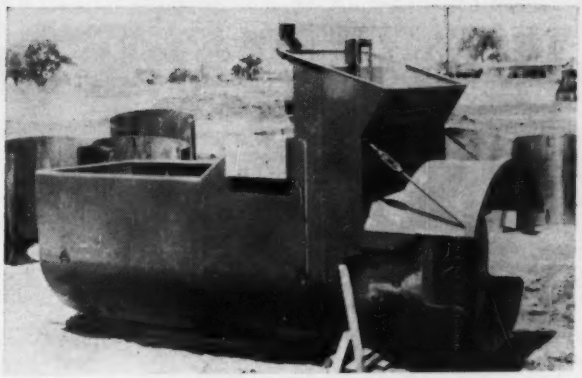
Precautions for monolithic and plain precast concrete pipe

Precautions that are advisable in installing monolithic and mortar-jointed plain precast lines include:

1. Avoid installation, if possible, when the air temperature exceeds 90 deg F.
2. Cover the ends of the line and other openings during construction to avoid damaging air drafts.
3. Fill irrigation lines with water as quickly as possible after construction and keep filled as much as possible thereafter.
4. Protect irrigation lines from water hammer with open standpipes.
5. Install open-air vents in irrigation lines at high points.



Close-up shows texture of outside of No-Joint pipe as it is extruded from machine. Vibrators are attached to bottom of inside form.



Machine moves to the left in the trench, extruding monolithic pipe behind it to the right. Machine is in essence a traveling slip-form.

in actual operation on this project, the Bureau of Reclamation (which by law is involved in the rehabilitation operations on the project) has approved a 2-ft cover for road crossings not subject to heavy and frequent wheel loads and for pipe along roads, if located at the outer edge of a roadway shoulder. For road crossings that carry heavy loads, a minimum of 2½ ft is recommended.

Cast-in-place pipe without reinforcing is obviously not suited for pressure pipelines. Although 30-in. test sections did not fail under internal pressure until heads in excess of 70 ft were reached, it has been the practice to limit the head to 10 or 15 ft.

Grade control

Since the bottom of the trench is the outside form for all cast-in-place processes, the grade control is governed by the bottom grade of the trench. Some excavation machines recently developed have rather elaborate devices for control of bottom grade. With the addition of fine grading, it is possible to meet any grade requirements specified for precast pipelines.

As recommended by the Bureau of Reclamation, it is advisable to cover the pipe with at least 24 in. of earth across and alongside of roadways and with 30 in. under heavy traffic. For pipe of 24- to 48-in. diameter, as shown in Table II, the load condition with 24 in. of earth cover, plus live load and impact, imposes a more severe condition than 20 ft of earth cover.

Actual flow tests are not available. A value of $n = 0.014$ in the Manning formula is the coefficient most commonly used. Unquestionably some cast-in-place lines have a higher carrying capacity than this would indicate, but in the absence of flow data engineers rightly have been inclined to be conservative.

Cost advantages

Some bids have shown a saving of 30 to 40 percent where cast-in-place pipe (CIP) was permitted as an alternative to reinforced precast concrete pipe (RCP), corrugated metal pipe (CMP) or vitrified clay pipe (VCP). For a sewer job in the City of Davis in 1957, for instance, No-Joint concrete pipe was bid at $6.00 per ft by the low bidder, and $9.00 per ft was the bid for the alternative of 16-gage CMP or VCP. Items for both CIP and conventional RCP were included in a project advertised for the South Sacramento Freeway by the California Division of Highways in 1960. A cost comparison was made by adding the average structure excavation and backfill costs to the RCP. The cast-in-place pipe proved to be substantially lower in price for all sizes. Comparative data are as shown in Table III.

Specifications

Specifications for cast-in-place pipe are currently available from many recently advertised jobs including those by the Bureau of Reclamation, the California Division of Highways and many cities and storm-sewer districts across the country. Several companies that construct such pipe have issued specifications. A committee of the American Society of Agricultural Engineers prepared a tentative draft which was turned over to the American Society for Testing and Materials. Subcommittee 111 of ASTM Committee C-13 has been working on specifications for cast-in-place concrete irrigation pipe for some time and has prepared a tentative draft for circulation to committee members. The specifications of the California Division of Highways require that "the concrete shall be placed in one operation around the full circumference of the pipe by means of a traveling form."

TABLE II. Stress in pipe at point of maximum moment, in psi

Pipe dia., in.	Live Load and Impact Plus 24-in. Cover	Live Load Plus 4 ft of Earth	Live Load Plus 10 ft of Earth	20 ft of Earth
12	189	*	*	*
18	284.4	*	*	*
24	385.5	118	129	145
30	387.8	182	207	243
36	386	200	233	285
42	384.2	220	260	326
48	380.4	202	241	312
54	319	222	270	354
60	317	235	287	380
72	312	260	317	425

*No calculations made.

TABLE III. Cost comparison per linear foot for RCP and CIP

	* 24-in. Pipe		30-in. Pipe		36-in. Pipe	
Bid No.	RCP	* CIP (No-Joint)	RCP	CIP (No-Joint)	RCP	CIP (No-Joint)
1	$ 9.97	$8.00	$11.35	$ 8.00	$15.53	$10.00
2	9.98	6.00	11.52	8.00	15.40	10.00
3	13.83	9.00	15.15	11.00	20.75	12.00
4	10.79	8.00	12.20	9.00	16.35	10.00
Average	$11.14	$7.75	$12.55	$ 9.00	$17.01	$10.50
% savings, average of all bids		30.4%		28.3%		38.3%
% savings, low bid only		19.8%		29.5%		35.6%

World Bank money
for engineering and construction

RALPH L. BLOOR, F. ASCE, Engineer, Public Utilities Division

International Bank for Reconstruction and Development, Washington, D. C.

The World Bank is, of course, primarily a financial institution. But since most of its lending is for heavy construction, it relies on the engineering profession, and especially on the civil engineer, for sound planning, sound design, and adequate and economical construction. It may be of interest to outline some of the goals the Bank strives to achieve for its borrowers and to suggest ways in which the engineering profession can help toward these goals.

The International Bank for Reconstruction and Development, to give it its proper name, began operations in 1946, having been established at the Bretton Woods conference of 44 nations. As its title implies, postwar reconstruction was an urgent part of its function and for this the first loans were made in Europe before Marshall Plan aid from the United States had become available. In 1948, however, the Bank became free to turn its attention to long-term loans for economic development in its member countries. These member countries now number 71; they comprise practically the entire so-called free world plus one communist country, Yugoslavia.

Bank seeks to make profit

Since loans are made to nations with greatly differing levels of development, it probably goes without saying that no rules can be established to govern all lending. But there are some rigid requirements. The Bank conducts its operations with a view to making a profit on its investments; loans are made only after the Bank has assured itself of the ability of the borrower to repay. The amount of a loan or the total amount of several loans in one nation is limited by this consideration. Loans may be made to private interests or to government agencies, but they must all be guaranteed by the member nation.

Loans must be for productive purposes and the projects they finance must be economically justified. International competitive bidding is required for the purchase of imported materials, which is that part of the cost normally covered by the loan. The Bank must assure itself that local currency costs can be met locally.

Of particular interest to engineers, the projects must be soundly planned. Although the Bank has only a small engineering staff of its own, it insists that competent engineers be employed in the planning of a project and be available during its construction and operation. It will use its own engineers to carefully check these facts. By these requirements the Bank establishes itself as a friend of the engineering profession throughout the world.

The Bank's original capital came from subscriptions from its member nations, of which only a small part was actually paid in. Borrowing operations started about the same time as lending operations on the strength of the pledged but unpaid subscriptions. Over the years some 290 loans totaling nearly 5¾ billion dollars have been made to 57 member countries and territories for over 600 individual projects. The types of projects financed can be broken down roughly into the following major use categories, although some of the projects serve multiple uses:

Power	$1¾ billion
Industry	$1 billion
Railroads	$1 billion
Waterways, ports, flood control	$½ billion
Agriculture	$½ billion
Roads	$½ million

Much smaller amounts have been loaned for communications, aircraft, and ships. About 38 percent of the total went to Asia and the Middle East, 23 percent to Latin America, 18 percent to Europe, 15 percent to Africa, and 6 percent to Australia.

Lending operations have now reached about $700 million a year and since the loans normally cover only the foreign exchange requirements of the projects, as distinguished from local currency requirements, the value of the work contributed to is over 2 billion dollars a year.

Estimates should be high enough

Now for some problems. Perhaps the first to be considered is the cost estimate. The Bank's experience with engineering cost estimates is much like that of everyone else—they are often inaccurate and they are usually too low. This has an especially critical effect on the Bank's operations because of the extremely limited resources in some of the borrowing nations. In an underdeveloped country, even a small overrun in cost may be very difficult to finance.

It is realized that making cost estimates for projects in these countries involves peculiar difficulties. Often the work to be done is unprecedented in that location; there is no previous work of similar nature from which parallels can be drawn. Often the productivity of local labor is difficult to assess. There will be cases where job training will have to start slowly from fundamentals. There will be cases where programs of adequate feeding will be necessary if workmen are to be kept in condition to maintain a sustained output. Sometimes the climate will be enervating to imported skilled labor. Sometimes access to the project site will be so difficult as to seriously limit the investigations needed for accurate planning.

What do we do about these and other difficulties? First we try to enumerate them all for each specific project, assess their effect as accurately as possible, and then add a sizeable contingency allowance to the estimate. I see no reason why contingency allowances for foreign construction should not normally be higher than for con-

struction in the United States. Under especially difficult circumstances they should be several times as high. Please don't be embarrassed, so far as the Bank is concerned, if your contingencies are a substantial part of your total cost estimate.

One way the Bank may become interested in a project is to be asked by a prospective borrowing nation to come into the country, study its needs and credit worthiness, and suggest projects for economic development. By this method projects are selected not only after some engineering study but also after careful investigation by trained economists and financial advisers. However, this procedure is not required as a prerequisite to lending.

Often a nation selects its own project and employs engineers to plan it, or the engineers may be employed to select it also. In some cases projects are selected, planned, and partly built before the Bank is called on for a loan, and the Bank may find it difficult to adjust the project to what it thinks the country needs and can pay for. Where a project has not been studied by the Bank or by any other expert economic or financial agency, the engineer should himself give some attention to its feasibility.

This sort of thing may well be new to United States engineers. A strong feeling of national pride in a new nation may lead to demand for a project larger than one which a next-door-neighbor nation has. At the same time there may be very few college graduates in the country—most of them lawyers more often than not. People equipped to judge accurately the economic needs and the ability to pay will often not be available locally.

In this atmosphere the professional duty of the engineer to serve the best interests of his client may require efforts beyond anything he normally does in the United States. In the United States a client's first reaction to an engineering plan is likely to be that the cost is 30 percent more than he can afford and it will have to be reduced. Engineers are also influenced by an informed public and press. In an underdeveloped country these things will be lacking and local government officials are likely to feel that, since a foreign engineer, who knows practically everything, has been hired under a contract to secure the right answer, it follows automatically that the answer he produces cannot be questioned by anybody.

How is an engineer to fulfill these rather unusual responsibilities? First he should learn what the country needs most and what it can afford and his engineering plans should be set in this framework. This may not be too difficult because the economies of underdeveloped nations usually are not complex, and in many cases the Bank or some other institution will have made basic studies.

Nature and size of projects

The main problem generally is concerned with the nature and size of the projects selected. The Bank restricts its loans to productive projects and it greatly prefers to loan to those that promise to set off a chain reaction of productivity. Partly for this reason one third of its loans have been for power. The demand for increased power maintains itself through many levels of productivity, and in many areas the capacity can be doubled every five or six years with a good rate of return on the investment.

Many of the nations that need help depend substantially on agricultural production and it is not sufficient simply to increase production by 10 or 20 percent. More likely the goal may be to double or triple agricultural production. To this end irrigation projects may be desirable and transportation in the form of waterways, roads or railroads will be needed. Increased industrial and natural resource production is of course essential.

The effect of projects on the export-import balance is important. Most projects will require substantial imports and the long-term Bank loans serve to spread these effects over many years. On the other hand, the project itself becomes more desirable if it promises eventually to reduce imports or increase exports.

Helpful parallels in the United States

In considering what sorts of projects may be less desirable I find it helpful to consider the stages the United States has passed through in attaining its present productive level. Consider our roads in 1920. There are underdeveloped countries where traffic is even less than it was in the United States at that time, and the establishment of a high type of road system cannot possibly be justified, even though all-weather roads of minimum type may be badly needed.

Flood control on a large scale did not start in the United States until the 1930's, although there had been many devastating floods before that. The reason was partly that concentrations of population and property did not justify it and partly, I suspect, because we simply could not afford it. For many years in many countries there will be less justification for flood control projects than there was in the United States in 1930. There are, of course, some notable exceptions where floods take a terrible toll of human life and where flood control can be combined with other productive purposes.

Reflect also on port development in the United States and its heavy mechanization as traffic became denser and the wages of labor rose. Contrast this with an underdeveloped nation with a few thousand tons of bananas to export and wages still at subsistence levels. We do, of course, hope to improve these conditions but it may take many years as it did in the United States, and in the meantime these countries cannot afford large investments in port facilities.

One of the most difficult problems, especially in connection with river developments, is to determine the proper size of a project. We have learned to abhor the partial development of a dam site in a manner that precludes further development. We have learned to prefer one large dam to several small ones. We have learned since the 1930's that it is quite difficult to develop too much power anywhere in the United States. We may forget that many of our inland waterway projects have been enlarged several times since their inception. Even if some underplanned projects in the United States were mistakes, the bulk of them were the most we could absorb and afford at the time. In underdeveloped countries these conditions are intensified. Electrical load prediction is almost impossible where nobody has used electricity before. The utilization of irrigation projects is slow where land tenures are based on centuries of tradition and where cultivation up to now has been done with a bent stick.

So here are two somewhat irreconcilable points of view which in the past have given rise to heated controversy in the United States, as witness TVA and the Snake River, and may be expected to pose problems for the engineer in underdeveloped countries. It is here that the ingenuity of the engineer may well come to the fore. It is easy, and much more spectacular, to plan a dam site for its maximum possible development. It is much more difficult to plan it in stages to be built as needed, but the latter plan will often be much better suited to the needs and resources of an underdeveloped country and in fact may very well be essential if there is to be any development at all.

(This article is a shortened form of the paper delivered by Mr. Bloor at the ASCE Annual Convention in New York, before the Waterways and Harbors Division session of its Committee on Flood Control and Navigation Facilities.)

New welded-steel seat tiers here described were added on the right to existing concrete tiers 25 seats deep. Additional tiers on the left were added about 12 years ago.

Automatic welding for stadium addition

RUSSELL ASCHINGER
Field Engineer
The Lincoln Electric Company
Nashville, Tenn.

Self-propelled tractor, on which welding gun is mounted, welds joint between tread and riser. Magnetized drive rollers hold unit against riser.

A 6,300-seat addition to the east side of Vanderbilt University's stadium at Nashville, Tenn., has been completed in record time by the use of a new automatic submerged-arc shop welding procedure.

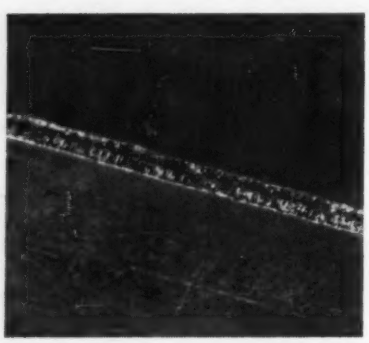
The new seat tiers were placed behind an existing concrete seat section containing 25 rows of seats. The addition consists of 21 sections which average 20 ft in width and contain 25 rows of seats, one above another. See photo on this page.

Special welding tractor used

Each of the new sections was fabricated in three parts in the shop of the Nashville Bridge Company, using Lincoln Electric Company welding equipment. The steel deck sections are made up of 3/16-in. hot-rolled steel plate, the tread and riser being formed in one piece by bending in a brake. Each riser rests on the edge of the tread below and is arc-welded to it with a continuous ¼-in. fillet. The bead was laid down in the shop at a speed of 42 in. per min by a self-propelled tractor on which is mounted a mechanized ML-3 squirtwelding gun, as shown in an accompanying photograph of one of the 63 sections in process of being shop-fabricated. The sections vary from six to ten rows each in depth and, when assembled at the site, three of them provide 25 rows of seats.

The large rolls on which the welding tractor rides are strong magnets which hold the unit tightly against the work, preventing any slipping or bouncing. The work is usually brushed clean before a weld is made, but the tractor is equipped with a small magnet to pick up metallic particles that may have been skipped. The buggy also has hardened-steel guide rolls which ride directly in the fillet to assure positive alignment between the gun and the joint. The guide rolls are spring loaded so that they will ride over the tack welds without jarring the tractor and disturbing the gun alignment.

Tractor and welding gun together weigh only 17 lb and have overall dimensions of 18 x 12½ x 6 in. For this job the tractor was laid on its side, so that the drive rolls were bearing against the riser plate and the gun electrode was inclined at an angle of 45 deg. Flux and electrode are fed through two hoses which lead to a remote-control cabinet. Once the squirtmobile is adjusted and started, the operator becomes merely an observer. The operation is stopped by pushbutton when the weld is completed. The buggy is then manually moved to another position. The plates are tacked manually before the continuous fillet weld is made.



Fillet weld deposited by squirtmobile has characteristic uniformity and smoothness in spite of fast travel speed of 42 in. per min. Over 10,000 ft of shop welding with this machine went into the structure.

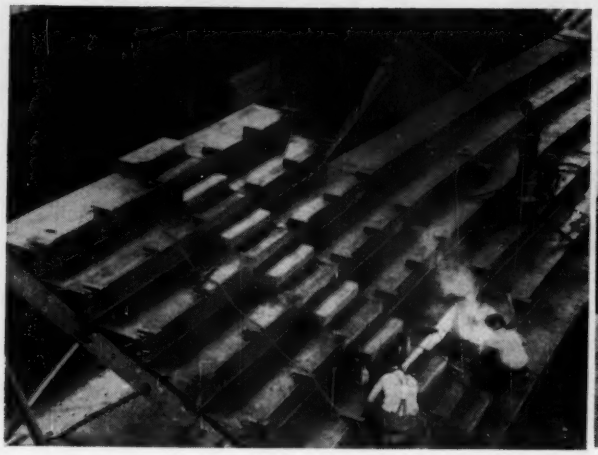
Stairway treads and risers welded on

Stairways for access to the rows of seats are made by welding on boxed treads and risers which have half the width and height of the deck-plate rows, as seen in a photograph. The steps, 39 in. wide, are rolled with a checkered plate pattern for nonskid service. Where a step comes on a deck plate, a Nabrico pattern is welded on —in the form of buttons of weld metal deposited in symmetrical rows, the same width as the steps. In the step area, additional reinforcement for the deck plates is provided by backing strips, 3/16 in. wide, intermittently welded behind the risers and under the treads.

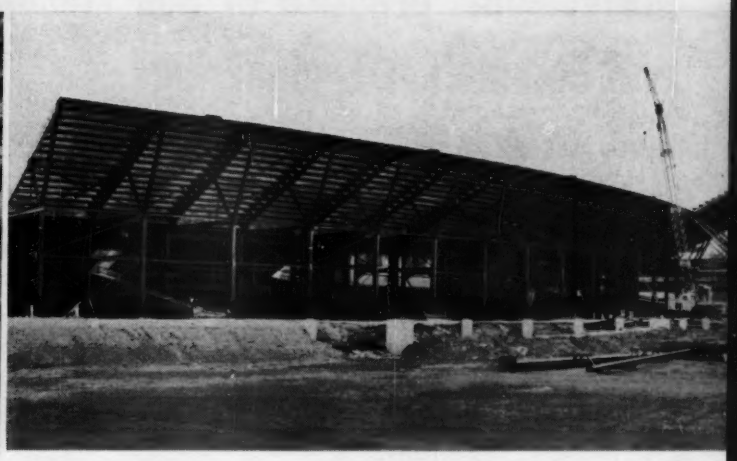
To provide a means of attaching the wood seat planking, small trapezoidal T-section clips were manually welded on in the shop. These clips, 8½ in. long and 3½ in. high, were welded along their web edges to the deck-plate treads, and spaced about 4 ft apart. Three holes, drilled in the flange of the clip, provide for the attachment of three lengths of planking.

Each riser-and-tread plate is bent on a ½-in. radius at the corner. An included angle slightly greater than 90 deg gives a ¾-in. slope upward on

A tier of seats is shop-fabricated by mechanized submerged-arc welding to attach bent tread and riser sections to each other. In foreground, seat plank clips are being manually welded to the deck plate.



Rear view of the 6,300-seat stadium addition indicates how the three new tiers of shop-welded deck sections were set in position by truck crane on a structural framework, behind an existing tier.



the tread for drainage. The riser is 13 in. high, the tread 26 in. deep.

The new stands are arc shaped to conform with the rest of the stadium. Because of the variation caused by the curve, the new addition is 580 ft long at the top and 523 ft long at the front. Therefore each of the 21 sections had to be tapered slightly so that, when they were welded together in the field, the desired arc would be formed.

The angle of inclination of the addition is 26 deg. The rear row is 30 ft higher than the front row, and the distance from front to back is 57 ft. Entrance to the seating area is through concrete ramps from the arcade below the seats, sloping upward to break through the lower tier of deck plates at five points equispaced along the length of the structure.

Erected on structural-steel frame

At the site the prefabricated tier sections were erected on a structural steel framework by a truck crane, then manually welded together. They are supported on three rows of wide-flange vertical columns, longitudinals, and diagonal bracing, as shown in Fig. 1. Spacing of the supporting columns is approximately 20 ft apart on centers from front to back, and from 19 to 21 ft on centers in the radial direction.

The seat plating was butt-welded at section joints except where designed for expansion. The seat framing was bolted with high-tension bolts to the supporting structure. All welding in the field was manual.

The deck sections rest at their ends on inclined structurals made up of two 12-in. channels with 3½-in. flanges, and weighing 30.9 lb per ft. These in turn are supported at their ends by welding to vertical 12 WF I-beam columns, and at the one-third and two-third points by 8 WF diagonals extending upward from a 12 WF longitudinal beam. The arrangement is indicated in the accompanying cross section, Fig. 1.

It is of interest to note that economy in design and improved moment distribution are accomplished by having the lower longitudinal or horizontal of the supporting framework webs flared out for a distance of 3 ft from the point where they join the end and central columns. Triangular plates were inserted in the shop and welded on to make this flare. Also the flanges are carried through the columns by plates welded to the column webs between the flanges.

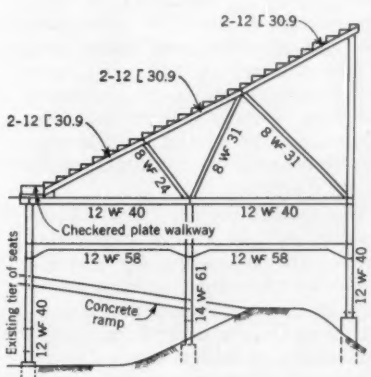


FIG. 1. Cross section through all-welded steel stadium addition shows how welded tread and riser plates are set on inclined channels carried by structural members of the framing.

Total shop and site welding on the stadium addition amounted to more than 12,500 ft, the greater part of it on the deck plates, where the speed and accuracy of the squirtmobile proved phenomenal.

Shop finish on the prefabricated tier sections consisted of two coats of bituminous paint on the under side and one on the top. Paint was stopped off 2 in. from all points where field welds were to be made. Field painting consisted of one coat of bituminous paint. Sand sprinkled over the field coat before it dried increased its nonskid properties. This bituminous paint also has a sound deadening effect to eliminate possible drumming in the integrated structure. This might be accentuated by the stamping of feet or organized cheering of adherents of the Vanderbilt Commodores.

The total cost of the addition here described, from foundation to completion, was about $220,000, which is about $35 per seat. A somewhat similar addition was put up 12 years ago on the west side of the stadium but it required far more time and expense for completion.

The welded steel addition to the stadium was designed and erected by the Nashville Bridge Company, under the direction of N. J. Olson, Chief Engineer, William Oring, Chief Draftsman, and Harold Hogue, Engineer.

Principles governing the professional practice of Soil Mechanics and Foundation Engineering

Report of ASCE Task Subcommittee on Professional Practice of Soils Engineering

WILLIAM W. MOORE, Chairman; Stanley J. Johnson, Bramlette McClelland, Ralph B. Peck

With the aim of finding means to encourage professional recognition for the practice of soil mechanics and foundation engineering and of resolving problems in the delineation of professional and subprofessional services, a Task Subcommittee on Professional Practice of Soils Engineering was established by the ASCE Committee on Professional Practice.

Utilizing comments solicited from 30 to 40 individuals representing different viewpoints within the Society, the Task Committee developed the attached statement, which has been approved in principle by ASCE's Board of Direction.

In view of the confused and sometimes conflicting policies observed in some areas, it is believed important to bring these recommended principles to the attention of individuals, private engineering firms and government agencies at all levels.

Definition:

Soil Mechanics and Foundation Engineering is defined as that branch of Civil Engineering which deals principally with soils and earth materials. As in other branches of the profession, engineering practice in this field includes evaluation of properties, analyses of behavior, economic studies, development of designs, and supervision of construction.

The Practice of Soil Mechanics and Foundation Engineering:

The professional practice of soil mechanics and foundation engineering involves several phases, the integration and productive use of which require a high degree of professional training, mature professional experience, and sound judgment.

1. One important phase of engineering practice in this field consists of determining appropriate plans for explorations and field tests. This phase frequently involves modifications in field procedures to conform with conditions disclosed during the early parts of the investigation.

2. A second important phase, also requiring professional judgment and experience, consists of planning and supervising laboratory testing programs, including selection of test procedures appropriate to the particular problems at hand.

3. A third and major phase consists of interpreting field and laboratory data, analyzing the probable behavior of feasible alternative designs, determining their relative costs, and presenting data and conclusions in an appropriate engineering plan or report. This phase requires an understanding of the accuracy and dependability of available data and an appreciation of the relationship of these factors to the successful performance of the completed project.

As in other branches of civil engineering, soil mechanics and foundation engineering utilizes subprofessional and other supplementary services such as the drilling of borings, sampling of soils and earth materials, performance of field and laboratory tests, and drafting and clerical functions. Since the soundness of each engineering decision is dependent upon the accuracy and applicability of data obtained in field and laboratory investigations, it is imperative that these investigations be under the supervision and control of the engineer responsible for the decisions resulting therefrom.

The greatest benefits from soil mechanics and foundation engineering services are not realized by adhering to specific exploration and test procedures and by performing routine computations. On the other hand, sound conclusions are seldom reached by reliance only upon visual examination and reference to previous experience. The achievement of appropriate and economical engineering decisions usually requires an intimate knowledge of the techniques of exploration, testing, and analysis, including an appreciation of the advantages and limitations of each. In addition, an appreciation of the broad engineering requirements of the total project is necessary so that soil mechanics and foundation engineering factors can be properly evaluated in relation to all significant features of the project.

Negotiations for Soil Mechanics and Foundation Engineering Services:

Negotiations for Soil Mechanics and Foundation Engineering services should be conducted in accordance with the principles stated in the ASCE Code of Ethics and ASCE Manual No. 38 entitled, *Private Practice of Civil Engineering*. These principles forbid soliciting or offering of professional engagements on the basis of competitive bidding or fee competition. An appropriate procedure for negotiation may include the following steps:

a. Obtain a list of engineers recommended by qualified sources, such as others who have been confronted with similar problems, or by inquiries within the professional community, and select from this list one or more engineers to be interviewed separately.

b. Conduct interviews on the basis of professional training, reputation, staff, availability, length of time required to complete the assignment, and experience in the specific type of service required.

c. Select the engineer considered to be best qualified to render the desired services.

d. Negotiate with the selected engineer to establish the scope and fee for services of the nature and extent required. For this purpose, the engineer should be provided with pertinent information concerning the proposed project and site and should be given the opportunity to inspect local terrain and conditions.

e. Agree upon appropriate arrangements for necessary subprofessional and other supplementary services. These services may be provided by the engineer or by others acting under his supervision and control. When supplementary services are to be or have been obtained by competitive bidding methods, the engineer should supervise and control this work and determine its compliance with specified criteria, but the engineer should have no financial interest in such supplementary services.

Clients who already have satisfactory knowledge of properly qualified engineers would normally omit the steps described in paragraphs (*a*) and (*b*) above.

THE READERS WRITE

Delta girder was proposed by Rankine in 1862

TO THE EDITOR: Some points regarding the delta girder, brought out by Louis Balog in the September issue (p. 71), were well taken and deserve elaboration. His statement that the shape is not new is certainly true, and one can go back beyond 1950 to find the idea presented.

A sketch and clear description of a delta girder was included in *A Manual of Civil Engineering*, first published in 1862 by the famous Scottish engineer and physicist W. J. M. Rankine.

In his *Manual* he discusses the design of built-up plate beams and states that "to give still greater stiffness and strength to the upper or compressed horizontal rib, it is . . . sometimes a triangular cell, rivetted to the upper edge of the vertical web, as in fig. 237, p. 522." This figure is here reproduced.

In the light of this, Mr. Balog's observation that practical applications often lag decades behind available knowledge becomes even more painfully accurate. His suggestion that free opportunity be introduced in the design of all publicly financed bridges shows a progressive tone, but presents certain other disadvantages.

Fig. 237

To many it should afford some satisfaction to observe the accelerated development of research facilities and activities by many private industries, as a positive and immediate step toward increasing available knowledge and decreasing the time lag before practical application.

GEORGE W. ZUURBIER, A.M.ASCE

Bethlehem, Pa.

Underdeveloped countries want technical publications

TO THE EDITOR: Most engineers read many technical publications each month. If they do as I do, they file the personally important material and the remainder heads for the trash basket. What a waste of good literature, especially when one realizes the low level of technical education throughout the underdeveloped countries of the world!

Perhaps your readers would like to do something about this situation in a very small and convenient way.

A recent copy of CIVIL ENGINEERING weighed 14 ounces. It can be sent overseas at a cost of about 13 cents. I have checked the weight of numerous monthly professional magazines and found that most can be mailed for less than 25 cents —a small price to pay for assisting in the "peace race."

Interested engineers might start by mailing a single magazine each month to a small private engineering college in Mysore State, South India. This college has sprung up out of the pure necessities and efforts of the people in the area. The address is:

Librarian
Manipal Engineering College
Manipal, South India (Mysore State)

Other colleges that can use technical magazines are:

The Royal College, Nairobi, Kenya
Kenya Politechnic, Nairobi, Kenya
Ghana University, Legon, Accra, Ghana
Chulalongkorn University, Bangkok, Thailand

HUBERT R. O'REILLY, A.M. ASCE

6149 Delafield Ave.
New York 71, N.Y.

Local planning and zoning—a job for the engineer

TO THE EDITOR: The industrial East developed without much special planning but the concentration of population has now brought the public to recognize the need for such planning. What are civil engineers doing about it? The architects and recently educated planners are apparently taking the lead in these matters, and the implication is that the engineers will not be brought into the picture. But this planning work is just what the civil engineer should be doing. At least, he should be in the group that is doing it but he will not be there unless he exerts himself and is willing to give of his time and talents.

Civil engineers should be active in their local planning and zoning commissions. This work is becoming increasingly important. Of course it involves service for the public welfare at a salary of zero. It means spending many evenings attending planning sessions and public hearings.

One often hears that our profession is not properly appreciated by the public. If this is so, let us get busy and render the service that will earn us this recognition and appreciation. Do not for a moment think that local planning and zoning is of little value and offers no challenge. You will find when you enter such work that there are many and difficult problems to settle. In fact, the local planning and zoning commission in a city or town is likely to be the most powerful agency there, as far as the development of the area and the welfare of the people are concerned.

By direct contact with the public, by wise conduct of affairs, and by the use of good engineering principles and judgment, the civil engineer can do more to earn respect and recognition in the minds of the public than he could by writing magazines full of words praising his profession. For example, a civil engineer on the staff of the State Highway Department of Connecticut has been serving on the local planning and zoning commission of his town for several years. He has earned such respect that both political parties come to him for help with a wide range of problems.

I particularly urge the younger members of ASCE to do likewise.

CLARENCE W. DUNHAM, F. ASCE
Chairman, Hamden (Conn.) Town Plan and Zoning Commission
Co-Vice-Chairman, Regional Planning Agency of South Central Conn.

Hamden, Conn.

Bus terminal story corrected

TO THE EDITOR: In my article, "Bus Terminal Extended Upward Three Stories," which appeared in the October issue, pp. 59-61, I wish to make the following corrections.

In Table I the L. L. values are all correct, however, the (L.L.)/2 values for members U_6L_7 down to L_3 U_3 are incorrect. This error then effects the D.L. + (L.L.)/2 column.

Then in Table II the dead load of the steel stress for member L_2-L_3 kips should have been + 651 kips, and not + 451 kips as shown. This would make the total stress in member L_2-L_3, after D.L. + prestress + live load, equal to + 2,587 kips instead of + 2,387 kips.

MAURO A. CETRA, M. ASCE
Regional Engr., American Inst. of Steel Construction

New York, N.Y.

Unretouched photo showing the smooth flow line of a 48" NO-JOINT Concrete Pipe storm drain in Omaha, Neb.

Cast-in-place NO-JOINT pipe has lowest installation and maintenance cost. 100% perfectly bedded everytime!

Smoother Flow through NO-JOINT Concrete Pipe

ENGINEERS: Cast-in-place, Roman Arch design NO-JOINT Concrete Pipe can *save 20% and more* over other pipe.

NO-JOINT Conduits have the *smoothest flow line;* efficient, clean-line design all the way! Hundreds of miles of NO-JOINT pipe are now in use for storm drains, sanitary outfall sewers, culverts and irrigation projects. Sizes: from 24" to 72" ID.

NO-JOINT pipe lines have *no joints.* So your joint leak problems are *ended* for good! Think how this steps up *maintenance savings!*

Flexural strength is *uniform* throughout its length. Bearing loads are *uniformly resisted.* The patented NO-JOINT construction process assures *uniform* pipe thickness. There's no chance for variations in shell strength.

CONTRACTORS: Are you making the *profit* you should on concrete pipe installations? Here is how you can *increase profit* and still have *low bid* on the big jobs:

TERRITORIES: **Many profitable NO-JOINT territories are still available. Write or phone for information today.**

FREE CATALOG: **Large, colorful catalog graphically describes the NO-JOINT cast-in-place process. Write for your copy today.**

When you install 100% perfectly bedded NO-JOINT Concrete Pipe you produce a *highest quality* product at *lowest cost.* You eliminate the high cost of backfilling and tamping to the spring line. There's no costly hauling and handling of pipes; less trenching and backfilling. Black top and labor cost are *greatly reduced.* There are *no pipe inventories* to maintain; *no capital investment inventories* to tax!

NO-JOINT can put you in the concrete pipe manufacturing business for as little as $15,000. When you are a NO-JOINT distributor, you add *manufacturer's profit* to your normal contractor's profit! Write today for information on NO-JOINT *licensed territories* or *rental* of NO-JOINT equipment.

NO-JOINT CONCRETE PIPE CO

SHerwood 2-8549
P. O. BOX 609A
YUBA CITY, CALIFORNIA
U. S. A.

Arch Design
NO-JOINT
cast-in-place
Concrete Pipe

DOMESTIC DISTRIBUTORS

Southwest No-Joint Distributors
137 West D, Glendale, Arizona

Central Calif. No-Joint C. P. Co.,
391 Sutter St., San Francisco, Calif.

G. G. Williamson Co.,
P. O. Box 1091, Chico, Calif.

Irrigation Installation Co.,
P. O. Box 88, Yuba City, Calif.

No-Joint C.P. Corp. of So. Calif.,
341½ N. La Brea, Los Angeles 36, Calif.

Wm. Lynch Company,
P. O. Box 425, Dixon, Calif.

U. S. No-Joint Concrete Pipe Co.,
Rt. 1, Box 41, Evergreen, Colo.

Missouri No-Joint Pipe,
1518 Sulphur Ave., St. Louis 10, Mo.

Highway Construction Co.,
720 Umi St., Honolulu 17, Hawaii

Nevada No-Joint Const. Co.,
P. O. Box 88, Yuba City, Calif.

Assoc. with Morris-Knudsen Co.,
San Francisco, Los Angeles, Mexico, D. F.

FOREIGN DISTRIBUTORS

The Hume Pipe Co.,
Germiston, South Africa

J. Wright & Sons
Durban, South Africa

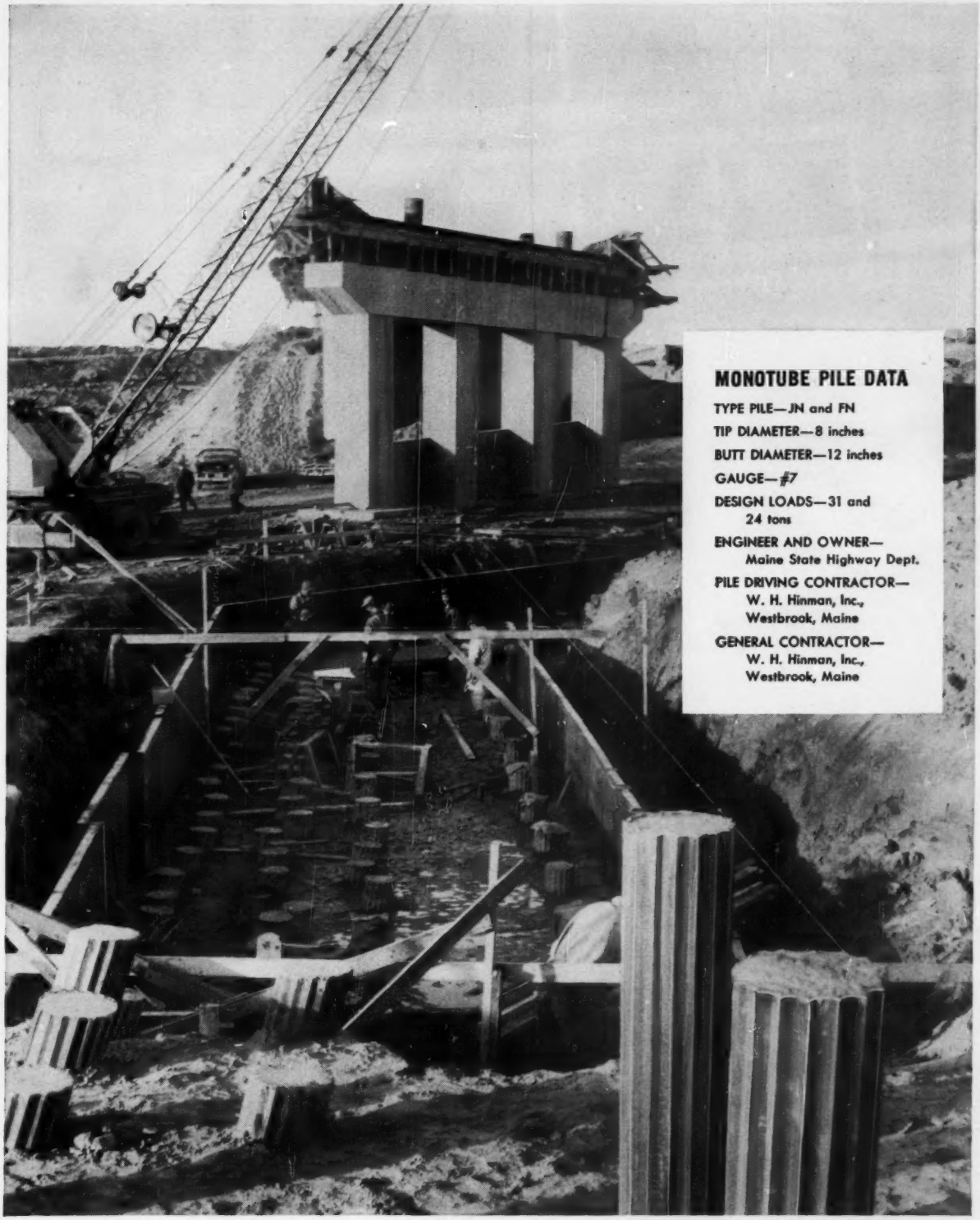
Super Concrete Pipe, (Ltd. S.A.)
Capetown, South Africa

E. P. Lough & Co. (Aust.) Pty. Ltd.
North Sydney, N.S.W., Australia

Keystone Contractors Ltd.,
Windsor, Ont., Canada

Structural Engineering Works, Ltd.,
Fort Bombay 1, India

No-Joint Concrete Pipe De Venezuela, C. A.,
Caracas, Venezuela



MONOTUBE PILE DATA

TYPE PILE—JN and FN

TIP DIAMETER—8 inches

BUTT DIAMETER—12 inches

GAUGE—#7

DESIGN LOADS—31 and 24 tons

ENGINEER AND OWNER—Maine State Highway Dept.

PILE DRIVING CONTRACTOR—W. H. Hinman, Inc., Westbrook, Maine

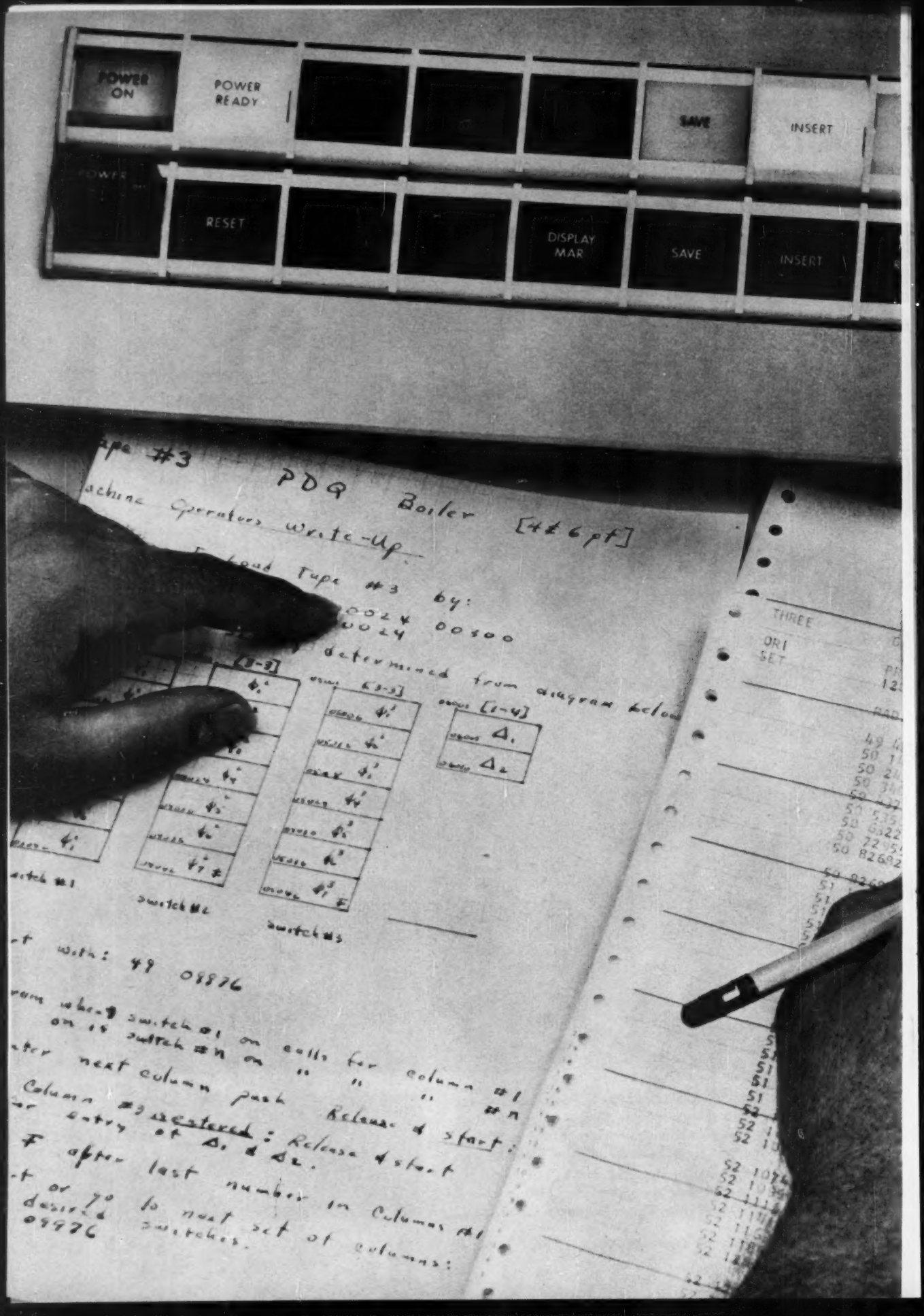
GENERAL CONTRACTOR—W. H. Hinman, Inc., Westbrook, Maine

STRENGTH AND STABILITY with cold-rolled Monotube steel piles for this skew bridge, Portland, Maine. High yield-strength Monotubes overcome severe driving conditions and resist horizontal forces inherent in skew bridge design.

Tapered, fluted Monotube piles are available in lengths, diameters and gauges to meet every requirement. The Union Metal Manufacturing Co., Canton 5, Ohio — Brampton, Ont., Canada.

UNION METAL

Monotube Foundation Piles


POWER ON
POWER READY
SAVE
INSERT
RESET
DISPLAY MAR
SAVE
INSERT
PDQ Boiler [4 & 6 pt]
switch #1
switch #2
switch #3

Cost of one-dimensional criticality computations drops from an average of $75.00 to $7.50 per problem

Faster computing, less travel time are the reasons why General Nuclear Engineering Corporation has realized such cost savings since it installed an IBM 1620 Data Processing System at its Dunedin, Florida plant.

Since its main computing facilities are not located at Dunedin, General Nuclear has found that the new 1620 eliminates much of the travel time and expense involved in taking problems to off-site computers. In addition, the 1620 performs the simpler criticality computations 10 times faster than the computer previously used at one of General Nuclear's off-site data processing centers.

General Nuclear uses its new 1620 for other problems, too...heat transfer calculations, various transient codes, mathematical routines for the physics and engineering departments, multi-group calculations, and many other jobs you might expect only a much more expensive computer to be able to handle.

This isn't all. General Nuclear uses the 1620 to do statistical analyses and variance calculations on input data for programs run on off-site large-scale IBM computers.

For information on this highly versatile, low-cost data processing system, which rents for as little as $1600 a month, contact your local IBM Representative.

Easy to program. FORTRAN, IBM's scientific computer language is available for the 1620. General Nuclear scientists use a special scientific interpretive program—FIDO—written by the Manager of their Computing Section.

IBM®
DATA PROCESSING

ASCE NEWS

ASCE Adopts Policy Statement on Surveying

At its meetings during the Annual Convention the ASCE Board of Direction acted on recommendation of the Conditions of Practice executive committee to adopt an amended policy statement urging each state registration board to develop progressively, and as rapidly as circumstances will permit, its requirements for the practice of land surveying, so that the status of the practitioner in the field shall be comparable to that of professional engineers practicing in other fields.

In the transition period in which the status of the land surveyor is being developed along the lines of the status of the professional engineer, the Board recommended that:

1. Persons now registered as land surveyors shall retain all rights and privileges accorded by law to such registration.

2. Such persons shall not be obligated to become registered professional engineers.

3. Such persons shall be entitled to professional engineer status when they meet the specific requirements for professional engineer registration, as determined by the State Boards.

4. Engineers, in the states where a land surveyor's law does not exist, are urged to encourage the development of legislation governing land surveying (using where possible, the framework of the legislation pertinent to professional engineering), which would allow the land surveyors in those states to participate in the transitional period of development of the land surveyor's status to that of other professional engineers.

Hoover Medal Presented During UEC Dedication

Dr. Mervin J. Kelly, former chairman of the Board of Bell Telephone Laboratories, Inc., has received the 1961 Hoover Medal for "distinguished public service." The Medal, established in 1930 by the four original Founder Societies, was presented in person by former President Herbert Hoover for whom it is named, during the dedication of the United Engineering Center on November 9 (page 48).

The citation, which was read by Walker L. Cisler, chairman of the Hoover Medal Board of Award and president of the Detroit Edison Company, hails Dr. Kelly as "Engineer, scientist, distinguished leader in industrial and military research whose dedicated efforts and engineering skill have contributed to greatly improved communications; who has furthered the cause of engineering service to mankind through inspired leadership in the creation of a great United Engineering Center."

Dr. Kelly received his bachelor of science degree from the Missouri School of Mines and Metallurgy in 1914 and his Ph.D. in physics at the University of Chicago in 1918.

He began his Bell System career as a research physicist with the Western Electric Company, in 1918. His work for the first ten years was in the areas of thermionic emission, gaseous discharge phenomena, and electron dynamics. His area of technical interest was broadened in 1928 with work on the applications of acoustics in telephony. In 1934 he was appointed development director of transmission instruments and electronics at Bell Telephone Laboratories, Inc., and in 1936 director of research. In 1951 he was named president, and he became Chairman of the Board in 1959 shortly before his retirement.

An early and active supporter of the plan to erect the Center, Dr. Kelly headed the highly successful industrial drive for funds.

Dr. Mervin J. Kelly (left) receives the Hoover Medal for 1961 from former President Hoover. At right is Walker L. Cisler, chairman of the Hoover Medal Board of Award.

Sanitary Engineers Plan More Active Program

At the annual meeting of the Board of Trustees of the American Sanitary Engineering Intersociety Board, Inc., plans were formulated for increased participation of diplomates in the program for the advancement of sanitary engineering. Chairman Thomas R. Camp reported increased activity and progress of the committees during the past year and said he hoped to further strengthen their effectiveness by the appointment of many nontrustees.

Officers elected for the coming year were: Chairman, Thomas R. Camp, of Camp, Dresser & McKee; vice chairman, Richard Hazen, of Hazen and Sawyer; secretary, Thomas R. Glenn, Jr., of the Interstate Sanitation Commission; and treasurer, Frank A. Butrico, of the U.S. Public Health Service.

The following were elected members of the Board of Trustees to represent

the sponsoring organizations for the next three years: American Institute of Chemical Engineers, William L. Faith; American Public Health Association, Roy J. Boston; American Society for Engineering Education, Gordon M. Fair; American Society of Civil Engineers, Blucher A. Poole; American Water Works Association, Robert D. Mitchell; Water Pollution Control Federation, David B. Lee; and Trustee at Large, Thomas R. Glenn, Jr.

The American Sanitary Engineering Intersociety Board, Inc., was organized to improve the practice, elevate the standards, and advance the cause of sanitary engineering in the interest of better serving the public. Through its certification program, applicants who meet the rigid requirements of the Board are designated diplomates of the American Academy of Sanitary Engineers. The fields in which certification is granted are Sanitary Engineering (general), Water Supply and Waste Water Disposal, Public Health, Industrial Hygiene, Air Pollution Control, Industrial Hygiene, Air Pollution Control, Radiation Hygiene and Hazard Control.

Robert D. Mitchell has been named chairman of the Specialty Committee; Harold B. Gotaas heads the Committee on Sanitary Engineering Education; and Allen D. Brandt continues as chairman of the Committee on Terminology of the Sanitary Engineering Profession.

All communications with the Board of the American Academy of Sanitary Engineers should be addressed to P.O. Box 143, Highland Park, N.J.

More ASCE Student Clubs Anthorized

Formation of three more ASCE Student Clubs was authorized by the Board of Direction at its October meeting, bringing to nine the total number of such groups in operation. The new clubs are at Indiana Technical College, Fort Wayne, Ind.; St. Martin's College, Olympia, Wash.; and Lamar State College of Technology, Beaumont, Tex.

ASCE Student Clubs are formed for the purpose of stimulating interest in civil engineering, professional development, Engineer-in-Training examinations, and ASCE. They are for schools that have not been accredited by ECPD, but whose graduates are eligible for the Engineer-in-Training Certificate.

Division Doings

[*Editor's Note:* An important feature of the January issue will be a forecast of what may be expected in 1962 in the engineering field of each of the ASCE Technical Divisions. A review of recent accomplishments will accompany the forecast. Top men in the various Divisions have consented to prepare this significant round-up of civil engineering activities.]

City Planning Division amends purpose

As announced in the November issue, the scope of the City Planning Division was enlarged by the Board of Direction at its October meeting. Its stated purpose now is: "To promote a broader understanding of and to contribute to the development of the art and science of city planning by the civil engineering profession, through such activities as will encourage (*a*) studies for the purpose of inducing new and improved principles and procedures of planning; (*b*) participation in Society and inter-Society assignments; (*c*) preparation, presentation and publication of papers and discussions; (*d*) publication of manuals of value to the profession, demonstrating the proper application of planning principles; (*e*) improved curricula for the training of civil engineers; and (f) programs for the continued education and professional growth of civil engineers, particularly those engaged in city planning."

Construction Division plans basic research

Plans for studies of the basic principles of construction management are being made by the Construction Division's Committee on Construction Research. Detailed assignments for developing proposals for projects were made during a recent meeting of this administrative committee held in the UEC. The committee reported plans to establish contacts with various research agencies, such as universities or research institutes, for the formulation of projects. It is anticipated that financing will be offered by the construction industry.

Areas of study planned include the following: Evaluation of contract bidding systems; study of concrete form work techniques; methods for determining the rate of progress; incentives for construction manpower; problems involved in the variety of construction permits required; systems for the development of competent construction management; and systems for the control of concrete mixing and placing.

Members of the Research Committee are William W. Moore (chairman), Gordon F. A. Fletcher, John J. Manning, Donovan E. Oelschlager, Herrol J. Skidmore, Arve S. Wikstrom, George A. Young, and Carl B. Jansen (contact member from the Division executive committee).

New Construction Division committee

An organizational meeting for a new Construction Division Committee on Construction Education and Management was held on the University of Denver campus this fall. Official purpose of the new committee is: "To stimulate and advance the education of civil engineers in construction management, techniques, and operations; to study the variety of problems involved in the management of construction, including the qualifications required for management and practices which will facilitate effective management."

Committee members in attendance were Ben C. Gerwick, Jr., of Ben C. Gerwick, Inc., San Francisco; John V. Otter, of the Morrison-Knudsen Co., Boise, Idaho; David A. Day, dean of engineering, University of Denver; Prof. William L. Richards, Cornell University; and Prof. C. H. Oglesby, Stanford University (chairman). Admiral Joseph F. Jelley, USN (retired), chairman of the Construction Division, also attended and outlined the purposes for which the committee was established.

New task force for Hydraulics Division

Compilation and appraisal of present knowledge, experience, and research on the problems of salt-water intrusion will comprise the first-year program of the Hydraulic Division's new Task Force on Salt-Water Intrusion, which is attached to the Committee on Ground-Water Hydrology. Overall plans call for a program of activities that will enable the Task Force: (1) To be aware of the extent of salt-water intrusion in both coastal and inland areas of the U.S.; (2) to recognize sources and causes of intrusion; (3) to analyze methods of control; (4) to keep abreast of and encourage research on intrusion and methods of control; and (5) to encour-

During the ASCE Convention in New York, the Joint ASCE-ASTM Committee had a shirt-sleeve session on Nomenclature in Soils Mechanics and Foundations. Shown, left to right, are: Dan Morris*, R. G. Ahlvin*, S. R. Stearns, D. M. Burmister*, A. L. Johnson*, C. A. Leonards, J. K. Mitchell, and T. H. Thornburn.* Other members of the group are Ralph Fadum, A. A. Wagner,* and E. D. Appalonia.* (Names starred represent the American Society of Testing Materials, but are usually also members of ASCE.)

age presentation and publication of papers in the field.

The members of the Task Force are Norbert J. Lusczynski (chairman), Clarence B. Sherwood, and David B. Willets. Matthew I. Rorabaugh is contact member from the parent committee (on Ground Water Hydrology). Mr. Willets is with the California Department of Water Resources; the others are members of the Ground Water Branch of the U.S. Geological Survey.

Pipeline Division Computing Committee

Formation of a new Committee on Electronic Computation has been authorized by the Pipeline Division's Executive Committee. The committee —headed by Ray R. Berman, supervisor of scientific applications for the Bendix Computer Division, Los Angeles—hopes to hold its first meeting during the Houston Convention.

Formation of the committee was authorized following recent circulation of a questionnaire among pipeliners, both members and non-members. Returns from the questionnaire give strong indication that the use of electronic-computing equipment, both digital and analogue, is firmly established in the pipeline industry and will increase in the future. A majority of the respondents also wish the Society to support and promote the use of electronic-computing equipment for pipeline work similar to the work of computing committees in other Technical Divisions.

Membership on the new Committee on Electronic Computation is invited from ASCE members, having a background of experience in two of the following categories: (1) Digital or analogue computer work; (2) design, operation and/or management of pipelines; and (3) mathematical analysis of networks or hydraulics. Members interested in participating should write to Ray R. Berman, Chairman, Committee on Electronic Computer Division, 139 Maryland Street, El Segundo, Calif.

SOCIETY AWARDS AND FELLOWSHIPS AVAILABLE

DANIEL W. MEAD PRIZES:	*New contest closes June 1, 1962. See 1961 Official Register, page 152.*
FREEMAN FELLOWSHIP:	*1962 contest open. Grant offered by ASME. Applications judged regardless of Society affiliation. See Official Register, page 158, or contact ASME.*
J. WALDO SMITH HYDRAULIC FELLOWSHIP:	*No 1962-63 contest offered.*
RESEARCH FELLOWSHIP:	*$5000 grant for full-time research to member of the Society in any grade. Deadline for 1962 contest is January 1, 1962. See Official Register, page 160.*

ASCE ENGINEERING SALARY INDEX

Prepared Semiannually

Consulting Firms

CITY	CURRENT	PREVIOUS
Atlanta	1.38	1.38
Baltimore	1.16	1.14
Boston	1.26	1.23
Chicago	1.44	1.50
Denver	1.32	1.25
Houston	1.31	1.26
Kansas City, Mo.	1.26	1.19
Los Angeles	1.36	1.35
Miami	1.38	1.38
New Orleans	1.25	1.22
New York	1.30	1.29
Pittsburgh	1.11	1.07
Portland, Oregon	1.31	1.28
San Francisco	1.38	1.35
Seattle	1.13	1.13

Highway Departments

REGION	CURRENT	PREVIOUS
I, New England	1.03	1.03
II, Mid Atlantic	1.18	1.15
III, Mid West	1.32	1.26
IV, South	1.12	1.12
V, West	1.16	1.13
VI, Far West	1.20	1.16

Sole purpose of this Index is to show salary trends. It is not a recommended salary scale. Nor is it intended as a precise measure of salary changes. The Index is computed by dividing the current total of base entrance salaries for ASCE Grades I, II, and III by an arbitary base. The base used is $15,930, the total of salaries paid in 1956 for Federal Grades GS5, GS7 and GS9. Index figures are adjusted semiannually and published monthly in CIVIL ENGINEERING. Latest survey was June 30, 1961.

ASCE Membership as of November 9, 1961

Fellows	11,040
Members	17,051
Associate Members	19,988
Affiliates	124
Honorary	50
Total	48,253
(November 9, 1960	46,535)

EJC Reference on Law for Engineers

A new reference, entitled "Concerning Some Legal Responsibilities in the Practice of Architecture and Engineering and Some Recent Changes in the Contract Documents," is now available from Engineers Joint Council (345 East 47th Street, New York 17, N.Y.), for $1.00. Prepared by John R. Clark, Esq., of Barnes, Dechert, Price, Myers & Roads, Philadelphia attorneys, the document is based upon a report developed by the EJC-AIA Liaison Committee.

The 26-page booklet discusses the problems of liability in the practice of the design professions, reviews recent changes in AIA contract documentation, and points up areas of possible liability.

Texas Section President James R. Sims (center) presents the Section's spur tie clasps to Bernhard Dornblatt (left), Director of District 15, and to last year's Society President Glenn Holcomb. Presentation was made during the fall meeting of the Texas Section, held in Austin, October 5 through 7.

LOCAL SECTIONS MEETINGS

Illinois—Regular luncheon meetings at the Chicago Engineers' Club every Friday, at 12 noon; the Section's Soil Mechanics and Foundations Division will cosponsor a soil mechanics colloquium on the campus of the Illinois Institute of Technology in Chicago on Wednesday, January 17.

Metropolitan—Regular monthly meetings in the United Engineering Center, New York, the third Wednesday in each month, at 7:00 p.m. Dinner in UEC Cafeteria at 5:30 p.m.

Philadelphia—Regular monthly meeting sponsored by the Hydraulics and Sanitary Groups at the Engineers' Club on January 9, starting at 5:30 p.m. with cocktails and dinner.

Sacramento—Weekly luncheon meetings at the Elks Temple every Monday, at 12 noon.

San Diego—Monthly meetings in the Town and Country Hotel, the fourth Tuesday of each month, at 7:30 p.m.

St. Louis—Regular monthly luncheon meetings in the King Louis IX Room at Union Station, the fourth Monday of each month, at 12:15 p.m.

NOTES FROM THE LOCAL SECTIONS

(Copy for these columns must be received by the fifth of the month preceding date of publication)

T. D. Sherard, director and chief engineer of Alaska's Division of Highways told the **Juneau Branch of the Alaska Section** in October that he was proud of the progress made by the Division during its first year of operations and appreciated the help rendered by the local Bureau of Public Roads office during that period of formation. At this time, Alaska has nearly 600 mi of highway projects, worth approximately $24,000,000, under construction and more than 100 projects representing 840 mi of road under design. Though the State has made excellent progress in its highway program, the 600 mi of roadway under construction is barely noticeable in the vast area of Alaska.

Honored at the October meeting of the **Kansas City Section** was James M. Abernathey, recipient of the 1960 Daniel W. Mead Prize for Associate Members for his paper "Under What Conditions May a Professional Engineer Undertake Outside Employment." Mr. Abernathey is now associated with Ralph W. Spears, consulting engineer, of Kansas City. Featured speaker at the meeting Donald R. Lueder, president of Geotechnics and Resources, Inc., presented a talk on "Mapping the Moon." Mr. Lueder outlined a project which his firm had handled for the National Aeronautics and Space Administration during the year 1959-1960, which studied the feasibility of using earthbound platforms for mapping the moon. He also listed many of the reasons why we should consider this undertaking a necessity.

El Ferik Ibrahim Abboud, president of the Republic of the Sudan, on October 8 received an honorary scroll from the **Los Angeles Section,** on the occasion of his good will tour of the United States. During his stay in Los Angeles, the Sudanese President inspected work being done for Sudanese develop-

(Continued on page 84)

On November 3 and 4 the Tennessee Valley Section held a highly successful annual meeting, with attendance exceeding 340. Some of those responsible, either through their participation or prior committee work, were (left to right) Don Mattern, ASCE Vice President; Waldo Bowman, editor of "Engineering News-Record"; Al Fry, general meeting chairman; Carl Shreve, president of the host Knoxville Branch; G. Brooks Earnest, ASCE President; and Myron Jensen, president of the Tennessee Valley Section. (Story on page 84.)

William F. Edmonds (left), chief engineer of the Rust Engineering Company, spoke on "Critical Path Scheduling" before the fall meeting of the Alabama Section, held on October 13 in Birmingham; while Lloyd T. Taylor (right), of the processing division of the Chicago Bridge and Iron Company, described "The Freeport, Tex., Seawater Conversion Plant." Standing between the two gentlemen, expressing his appreciation on behalf of the Section, is Section President Harry E. Myers.

Steel reinforced

for longer life in storm sewer service!

Concrete pipe reinforced with strong USS AMERICAN Welded Wire Fabric solves drainage problems.

Albuquerque, like most southwestern cities, is spreading out. You see new construction almost everywhere you look. This photograph shows some of the activity that goes into transforming the wide open countryside into new residential areas. It was taken in the North East Heights development and shows the laying of reinforced concrete pipe for a storm sewer. In this project, approx. 17,000 lineal feet of reinforced concrete storm sewer pipe from 24″ dia. through 72″ dia. was laid.

The pipe shown is 72″ pipe, and every foot of it was *steel-reinforced* with USS AMERICAN Welded Wire Fabric to give it the strength and durability to withstand heavy loads and assure long service life. It was pre-tested to meet the rigid requirements of ASTM Specifications C76-57T, and will withstand loads exceeding 100,000 lbs.

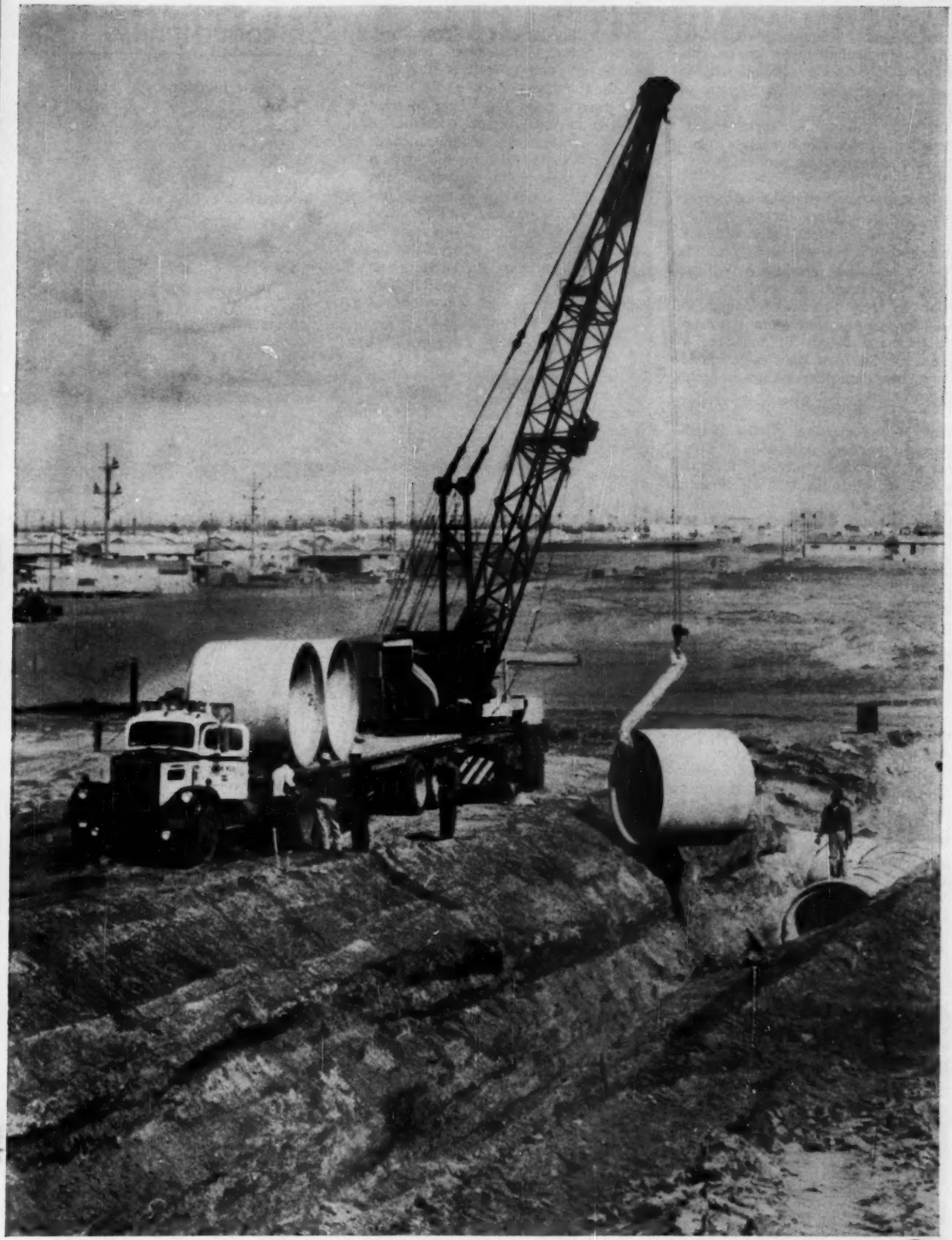
A large number of concrete pipe manufacturers are using USS AMERICAN Welded Wire Fabric to get greater strength and durability. This quality wire fabric is made on precision machines to the closest of tolerances ±0.003″—with center to center spacings held to ¼″. It is prefabricated from cold-drawn, 60,000 psi min. yield strength wire. All intersections are electrically welded to assure positive mechanical anchorage in the concrete. For more information about USS AMERICAN Welded Wire Fabric—write American Steel and Wire, Dept. 1476, 614 Superior Avenue, N.W., Cleveland 13, Ohio.

USS and American are registered trademarks

American Steel and Wire Division of United States Steel

Columbia-Geneva Steel Division, San Francisco, Pacific Coast Distributors
Tennessee Coal & Iron Division, Fairfield, Alabama, Southern Distributors
United States Steel Export Company, Distributors Abroad

Project: Storm Sewers, North East Heights, City of Albuquerque, N.M. **Engineers:** Gordon Herkenhoff & Associates. **Contractor:** C. R. Davis Contracting Company. **Product:** Reinforced Concrete Pipe ranging in size



from 24" to 72" dia. Reinforced with USS American Welded Wire Fabric.
Manufacturer: Pipe by American-Marietta Corporation. Reinforcement by American Steel and Wire Division of United States Steel.

This mark tells you a product is made of modern, dependable Steel.

ment projects by Daniel, Mann, Johnson & Mendenhall under an International Cooperation Administration contract, and talked with a group of officials representing the city's important civic and public works bodies. President Abboud is himself a member of the engineering profession.

Recently the **National Capital Section** elected officers for the coming year. Serving with David L. Chaney, the new president, will be Sylvester E. Ridge as vice president, William Campbell Graeub as secretary, and John H. Heckathorn as treasurer. In addition the Associate Member Forum has selected Ralph B. Schaeffer as president, David A. Blair as vice president, and Paul Manoukian as secretary-treasurer.

A recent meeting of the **Northwestern Section** consisted of dinner and a business meeting, followed by a field trip to the U.S. Department of Interior Bureau of Mines Research Center. Guides conducted tours of the Center, and the 62 members and guests who took advantage of the trip were able to study projects currently underway. Afterwards, Kenneth D. Baber, superintendent of the Research Center, and his staff answered questions regarding the Center.

The growing controversy within the construction industry between advocates of the single general contract and those of the separate contracts system was the subject of the October 10 meeting of the **Philadelphia Section.** Speakers at the meeting, which was held jointly with the Philadelphia Chapter of the American Public Works Association and the Philadelphia Post of the Society of American Military Engineers, were Charles B. McBride, of the General Building Contractors Association, and John Watson, of the Mechanical Contractors Association of Philadelphia. Mr. McBride, a proponent of the centralized, single contract system, briefly reviewed the history and growth of the construction industry since 1880, basing his argument for the single contract on the complexity of construction framing, installation, maintenance of equipment and uses in the overall building project. The opposition, Mr. Watson, explained the growth in importance of mechanical and electrical work in today's buildings—in some instances as high as 50-75 percent of the total cost—and suggested that direct contracts between owner and mechanical specialties contractors is preferred by 75 percent of those engaged in the construction industry.

The **Tennessee Valley Section** held its two-day annual convention at the University of Tennessee Center in Knoxville, November 3 and 4. Speakers at the general meeting sessions were ASCE President G. Brooks Earnest, Adolph Ackerman, consulting hydroelectric engineer, and Waldo Bowman, editor of *Engineering News-Record.* Moreover, participants in the six technical sessions came from far and wide. President Brooks Earnest, speaking before the luncheon meeting, honoring past presidents of the Tennessee Valley Section, on the "Need for Scientists and Engineers—Present and Future," voiced a stout defense of scientists who have been lost to U.S. Government service because of what he called the "witch hunt" for subversives in recent years. Mr. Ackerman, main speaker at a Conditions of Practice Session, spoke on "Atomic Power—A Failure in Engineering Responsibility," while Waldo Bowman, featured speaker at the homecoming banquet, described engineering works around the world. Elected as Section president and vice president, were Charles Sipe and Alfred Cooper, respectively. Plaudits to A. S. Fry, general meeting chairman, for the successful convention.

At a recent meeting of the Central Pennsylvania Section, Dr. A. Allan Bates (right), vice president of the Portland Cement Association, presented an illustrated lecture on "Construction in Russia," in which he emphasized the tremendous morale of the Russian people. Shown with him are (left to right) W. L. Raymond, Jr., secretary-treasurer; Jacob Frank, vice-president; and T. Robert Kealey, president of the Section.

ASCE CONVENTIONS

HOUSTON CONVENTION

Houston, Tex.
Hotel Shamrock Hilton
February 19-23, 1962

FIRST ASCE WATER RESOURCES ENGINEERING CONFERENCE

Omaha, Nebr.
Hotel Sheraton-Frontenelle
May 14-18, 1962

ASCE ANNUAL MEETING AND NATIONAL TRANSPORTATION ENGINEERING CONFERENCE

Detroit, Mich.
Hotel Statler Hilton
October 8-12, 1962

DISTRICT CONFERENCES

PACIFIC SOUTHWEST COUNCIL

San Diego, Calif.
El Cortez Hotel
April 5-7, 1962

PACIFIC NORTHWEST COUNCIL

Seattle, Wash.
Olympic Hotel
April 20 and 21, 1962

DISTRICT 9 COUNCIL

Indianapolis, Ind.
Marott Hotel
May 4 and 5, 1962

TECHNICAL DIVISION MEETINGS

AMERICAN POWER CONFERENCE

Chicago, Ill.
Sherman Hotel
March 27-29, 1962
Co-sponsored by
Power Division

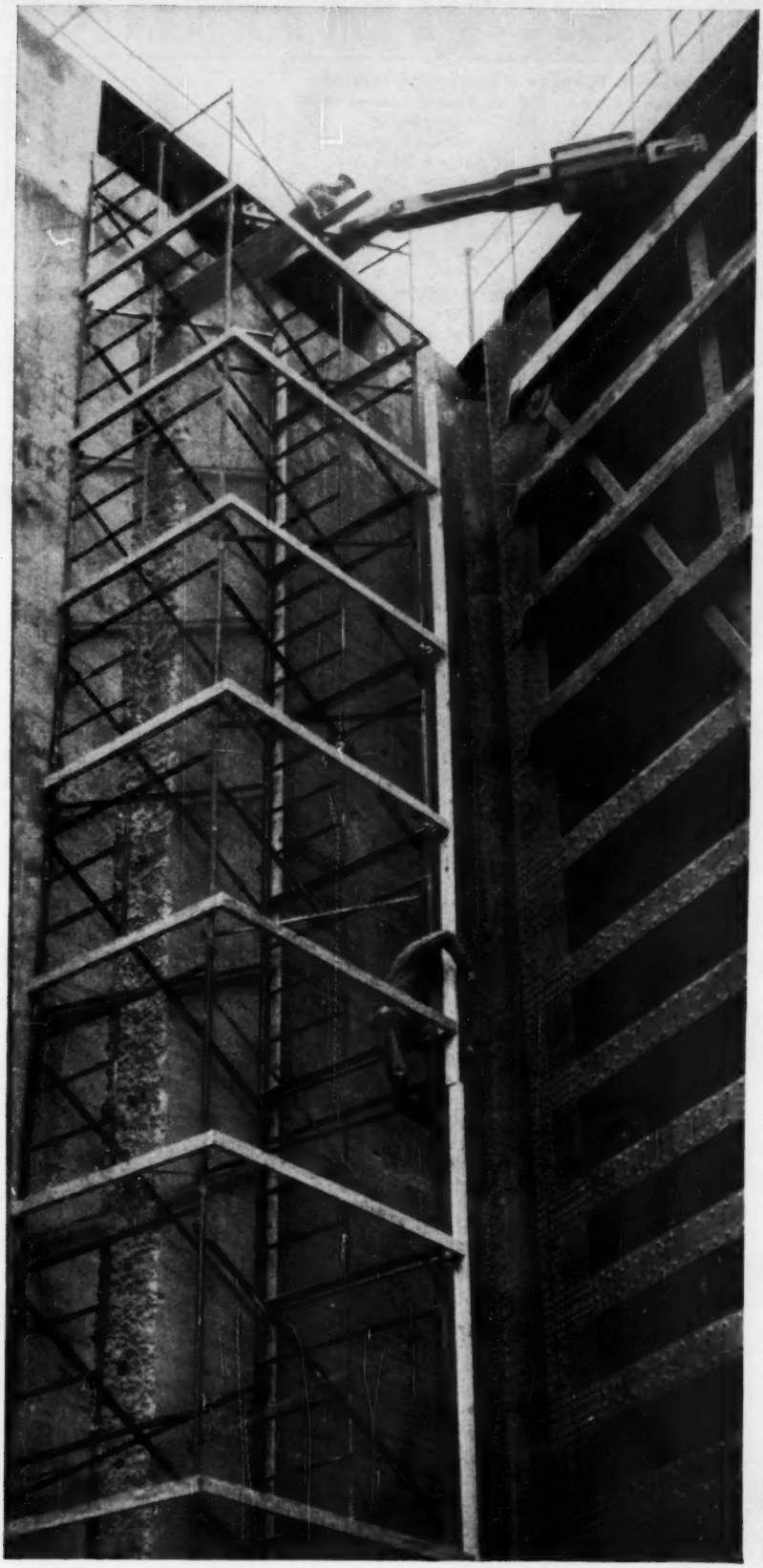
ENGINEERING MECHANICS DIVISION CONFERENCE

Austin, Tex.
University of Texas
April 26 and 27, 1962
Sponsored by
Engineering Mechanics Division

NATIONAL CONGRESS ON APPLIED MECHANICS

Berkeley, Calif.
University of California
June 18-21, 1962
Co-sponsored by
Engineering Mechanics Division

HOW TO MAKE LITTLE OF BIG REPAIRS



Polysulfide-epoxy adhesive speeds, simplifies concrete reconstruction on big river lock

After years of wear and weather, Lock #1 desperately needed reinforcing. Repair time was important. Shipping could not be interrupted for an extended period. Soil conditions were poor. Driving sheet piling proved impractical.

Through use of concrete adhesive combining THIOKOL polysulfide polymer and epoxy resin, engineers met the problems squarely.

By applying the compound to existing base structures (areas where concrete had worn and eroded), they were able to add new sections of reinforced concrete. Adhesive bond between old and fresh concrete provided by the polysulfide-base material proved *stronger than concrete itself*, in effect created one continuous structural unit.

Repairing sidewalls: polysulfide-epoxy adhesive used to grout steel dowels into existing walls, cured inside 24 hours. Well-anchored dowels tie old and newly-poured-in-place vertical columns of concrete. A strong, unified structure delivered well within limited time schedule.

Waterproof, practically indestructible, the bond produced by THIOKOL polysulfide polymer/epoxy adhesive has restored better-than-new serviceability to highways, bridges, buildings, dams, locks, reservoirs. Big job and small, all were done with great economies in time and dollars. *For full information, write for brochure CA-200.*

Thiokol®
CHEMICAL CORPORATION
780 N. Clinton Ave., Trenton 7, N. J.
In Canada: Naugatuck Chemicals Division, Dominion Rubber Company, Elmira, Ontario

THE YOUNGER VIEWPOINT

This month's editor is William R. Walker, Zone III committeeman.

Swan song

With this issue I am submitting my resignation as committeeman for Zone III. I have enjoyed the experience and my association with committee Chairman Walt Linzing. A good friend has reminded me that my viewpoint may be both sage and senile at times, but not so "young" anymore. I strongly urge Associate Members of Zone III to consider serving on this committee so that they may have an opportunity to express the joys and frustrations of the young engineer.

[Mr. Walker is transferring to the grade of Member. He has served ably on the Committee on Younger Members for two years. We are pleased to have had Bill on the committee with us and thank him for the work that he has performed for you, the membership of ASCE.—W. D. L.]

International engineering for young engineers

Dr. John Logan, F. ASCE, chairman of the Civil Engineering Department at Northwestern University, has submitted the following remarks on the need for competent engineering in foreign countries and the challenge it offers for all engineers, and especially for young engineers. Dr. Logan has made numerous trips to the Far East and Latin America for the World Health Organization and the U. S. State Department and knows first-hand of needs in these areas.

Peace Corps, Schweitzer, Dooley as symbols

"The Peace Corps, Albert Schweitzer and Dr. Tom Dooley are all symbolic of an international concern about the newly developing areas of the world. Eugene Black, chairman of the World Bank, has said that international cooperation in the social and economic development of these areas may well be the most important historical event of this century, surpassing in importance the world wars and the development of nuclear power.

Man still the slave?

"Why is it that civil engineers appear to have so little interest in development —particularly when a very good case can be made for the key role which the profession plays in this field? For in most of the emerging areas of the world, development must be based on man's ability to control his physical environment; until he has been able to provide adequate shelter, control the vectors of disease, protect himself against floods and droughts, provide for transportation, communication, irrigation and water supply, man must live as the slave, rather than the master of his physical environment.

How ASCE can help

"The nature of modern civil engineering, with its high degree of specialization, its dependence on groups of skilled analysts and designers and on teams for construction, rules out the possibility of any significant individual effort such as that of a Tom Dooley or an Albert Schweitzer. Civil engineers should, however, be playing a more important role in the Peace Corps and in development generally. As a start, ASCE might very well place more emphasis on the international nature of its membership and interests, and efforts should be made to interest more young engineers in considering a career in overseas work. Large areas of the world need the pioneering roads, bridges, dams and irrigation works which make social and economic development possible; the United States has by far the greatest single reservoir of talent and experience in this vital area."

This Younger Viewpoint committeeman strongly urges young engineers who have recently graduated or are about to graduate from college to consider accepting overseas engineering assignments for at least a year before they are encumbered with family responsibilities, mortgages and "security" which seem to deter most of us from accepting opportunities to be of service to our fellowmen in other countries. Any engineer, young or old, who devotes a year or two to assisting the underdeveloped countries of the world in overcoming their physical environment, will find in later years of reflection, that this time was the most satisfying and rewarding in his entire engineering career.

Peace Corps Opportunities

A plea for more volunteers with technical training comes from national director of the Peace Corps, R. Sargent Shriver. Of 13,000 replies to questionnaires so far received, he said, only 6,000 applicants have taken tests and only 470 are either in training or overseas. While tests continue, about 1,000 are expected to be in training by January and 2,700 by next June. According to Mr. Shriver, there is no limit to the number needed.

Need for more seminars

Do you have opportunity for as much additional study in engineering short courses and seminars as you can take advantage of? Need for additional seminars and technical sessions to advance engineering knowledge of the individual is a recurring question at meetings of the Committee on Younger Members. Please assist by clipping, marking, and mailing the coupon below. Results will be made known in the column below and every effort made to carry out the wishes of the members.

[*Editor's Note:* The letter by Clarence W. Dunham on "Local Zoning and Planning —A Job for the Engineer" on page 73 of this issue, is highly recommended reading.]

The Younger Member in ASCE

should / should not *(cross out one)*
encourage / sponsor

seminars and short courses to supplement those now available.

Subjects desired _____

_____

_____

Maximum total hours _____

☐ Prefer continuous day and evening sessions

☐ Prefer evenings, _____ nights per week

_____

Address (to assist in identifying metropolitan and college areas)

Mail to: Walter D. Linzing
4751 No. Paulina
Chicago 40, Ill.

A-M REINFORCED CONCRETE PIPE with CONCRETE and ROUND RUBBER JOINTS

The problem:

Installation of 8,000 ft. of concrete sewer pipe running parallel to a creek and below its water level. The problem was complicated by numerous springs and unstable ground conditions so serious as to allow opening the trench for only one or two lengths of pipe at a time.

The solution:

Long lengths of A-M's 60″ C. & R. R.* pipe reduced the total number of necessary joints. Quick, easy fitting of the joints cut installation time in spite of the problem of poor ground conditions. Tight joints far exceeded the maximum infiltration requirement for this Johnson County, Kansas project.

Write our technical staff for help in solving your problem.

*American-Marietta's Concrete And Round Rubber Joint.

MARTIN MARIETTA CORPORATION

CONCRETE PRODUCTS DIVISION

101 EAST ONTARIO STREET, CHICAGO 11, ILLINOIS, PHONE: WHITEHALL 4-5600

BY-LINE WASHINGTON . . . . .

·The federal government—already the nation's largest engineering employer—is going to increase its competition with private industry for engineering skills. This will be done by asking Congress for more "supergrade" positions (up to $18,500 a year for Grade GS 18), and more Public Law 313 positions ($19,000 a year); by formation of more "non profit" corporations to do research and development work for the government; and by other means including an intensified recruiting program. Most of the demand for "engineering" skills is in the area associated with space and military programs.

The government's drive has particular point, in view of a study of comparative salaries (private vs. government) recently completed by the Bureau of Labor Statistics. This indicates that maximum government salaries for engineers range about $1,000 less, on an annual basis, than do the average salaries of their counterparts in private industry in the first six government grades. In the top two government grades, maximum pay for engineers is as much as $4,000 under average industry pay. (The Bureau of Labor Statistics includes all "engineers" except sales, industrial and safety, in its classifications.) It is interesting to note, however, that government clerks and typists, in general, get several hundred dollars more per year than private industry pays.

* * *

Highway engineers in Washington are on the receiving end of a lot of criticism in a growing—and nationally important—public reaction against construction of huge freeway links in downtown areas. Gist of the criticism (and architects have now begun to join the battle) is that the engineers shouldn't be left alone to plan the freeways: They have become so blinded by the problem of moving masses of vehicles that they have lost sight of what the freeways are doing to the cities they're supposed to help; they refuse to consider any other means of transporting commuters than private automobiles and buses; too much valuable land is being gobbled up in huge and often unsightly interchanges and elevated structures.

Joining in the furor (over the so-called "inner loop" freeway cutting around the downtown heart of the Capital) are at least a dozen official and semi-official agencies, including the powerful (though advisory) National Capital Planning and Parks Commissions, city and surrounding county governmental groups, the city's new regional transit agency, and many civic groups. One result has been to throw future "loop" construction plans into considerable confusion, possibly a year's delay.

* * *

Federal officials and contractors' groups, at least, are getting much worried over a near-hysterical investment of many individuals in often shoddy and quite probably worse-than-useless family fallout and bomb shelters. In the Washington area alone, it is known that at least 300 such shelters have been built (though less than 30 building permits have been issued for them).

* * *

The Public Health Service has activated its eight new ($300,000) urban centers that will provide continuous monitoring of gaseous air pollutants. These centers, located in major city areas (Chicago, Cincinnati, Detroit, Los Angeles, New Orleans, Philadelphia, San Francisco and Washington), will sample and analyze sulfur dioxide, nitric oxide, nitrogen dioxide, carbon monoxide, ozone, hydrocarbons and total oxidants. The idea is to provide more sharply defined information on levels of pollution in the atmosphere over cities, for study in connection with health effects.

* * *

The government will hold general contractors increasingly responsible for dealing with their subs—wants as little as possible to do with contract disputes or subcontracts. That's the meat of a two-day seminar on construction contracting procedures, sponsored by George Washington University and Federal Publications, Inc., of Washington. A number of lawyers, contractors' representatives, and government officials attended.

* * *

A new architectural philosophy on the life of buildings will be interesting to engineers: Buildings should now be designed for an economic lifespan, not "forever," said William H. Scheick, executive director of the American Institute of Architects (at the annual meeting of the Structural Clay Products Institute). This new philosophy, said Mr. Scheick, will make possible a new look at many new building products and groups of products and many variations on more conventional designs.

* * *

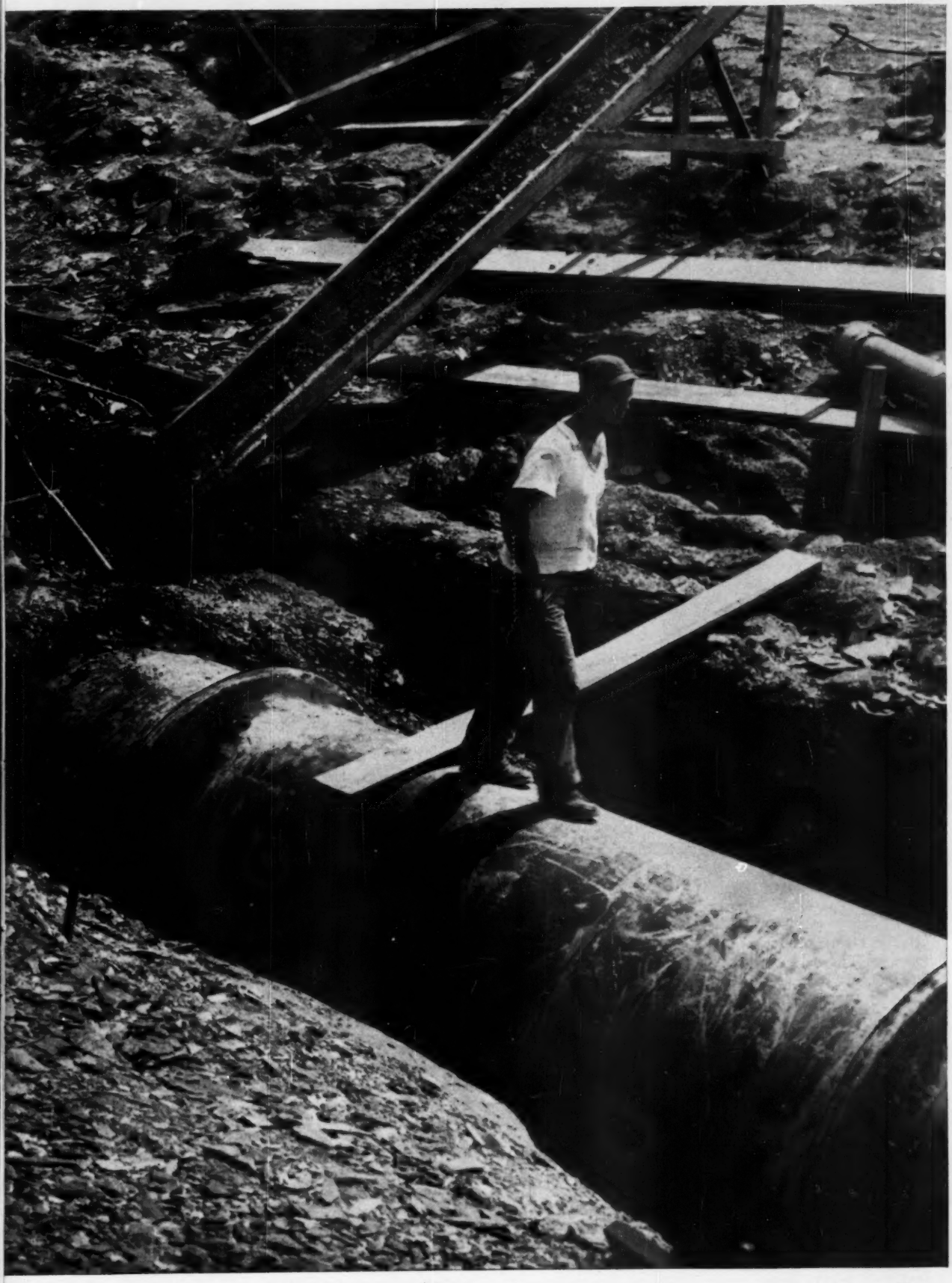
The Commerce Department's report on national transportation policy—which is expected to form the basis for a Presidential recommendation to Congress next session—is almost certain to contain a recommendation for some sort of user-charges on waterways operators (to repay the government for its expenditures on channels, locks, dams, etc.). And that is very sure to build up a hot battle on Congressional floors—waterways men have already formed a special group to battle any charges.

* * *

Highway investigations next year will take a very political turn. That's obvious in the charges of "payoff" by Congressman Gordon Scherer, second-ranking Republican on the Blatnik subcommittee, in commenting on the assignment of 180 miles of the Interstate reserve (285 miles in all for the whole nation, set aside to close last-minute gaps in the national system) mostly to West Virginia. Congressman Scherer complained that the West Virginia route (from Washington, Pa., to Charleston, W. Va.) wouldn't carry 5,000 vehicles a day even in 1975—thus should have had a much lower priority, if any, and was a simple payoff for political support. He demanded an investigation by the subcommittee.

* * *

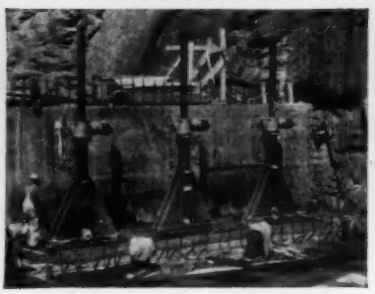
You can look for a push for more reclamation projects in the next session of Congress, despite any gestures toward economy in the general government spending area. The tipoff is the series of speeches that have been made throughout the West by Interior Secretary Udall, Reclamation Commissioner Dominy, and others—all using the now-popular term "conservation," rather than talking about more crops from more reclaimed lands.

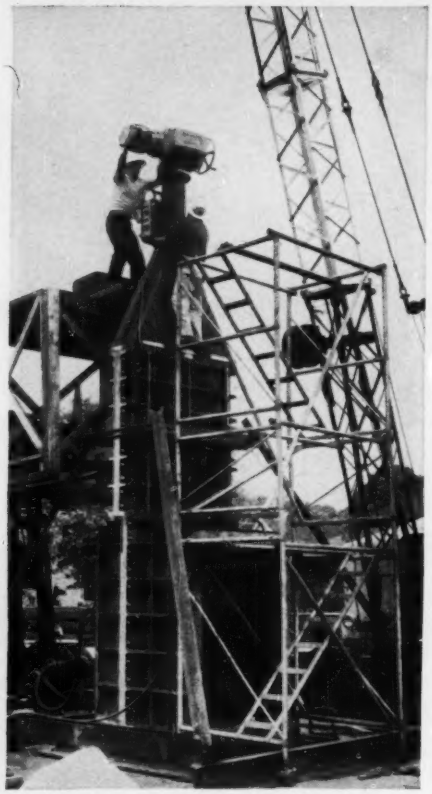


RODNEY HUNT SLUICE GATES WEAR A BONNET WITH A "BLUE RIBBON" ON IT

West Hill Dam at Uxbridge, Massachusetts, during construction. Two of three channel outlets are visible in center.

Three 48″ x 72″ Rodney Hunt Sluice Gates are permanently buried beneath the bonnets and operating equipment shown here.





Bonnetted gates for West Hill Dam were completely assembled and test-operated prior to shipment to assure Army Engineers that specifications were fully met.

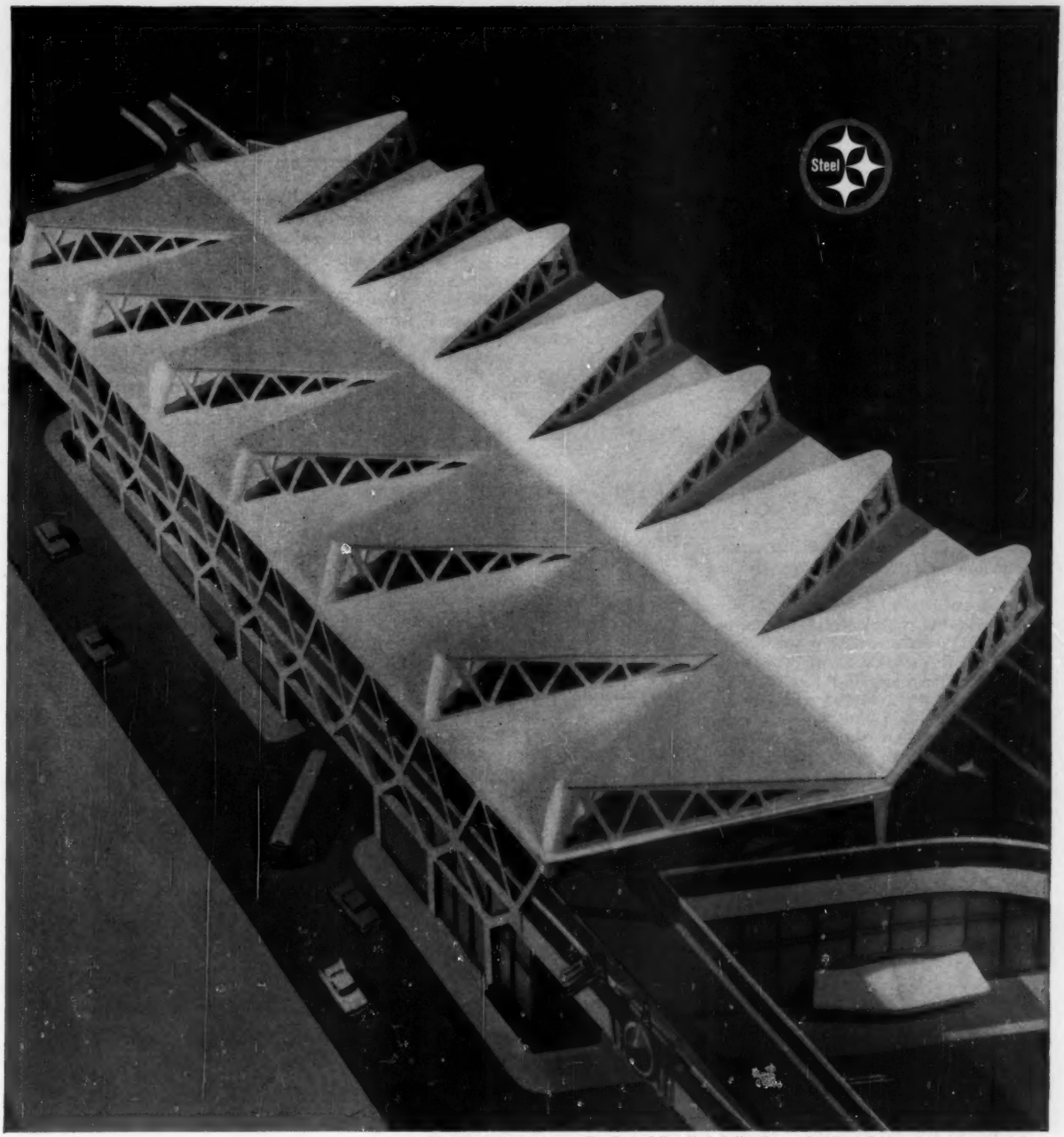
Earlier this year, a flood control project was formally dedicated in Uxbridge, Massachusetts. Known as the West Hill Dam, it is unusual for two reasons. The first is that plans for this project were drawn up 25 years ago following the great flood of 1936, but lay dormant until the disastrous 1955 flood stirred residents and industry in the area to action.

The second reason concerns the sluice gates which were built on a custom basis by Rodney Hunt to the special design of the New England Corps of U.S. Army Engineers. Installed in three channels under the spillway, they will be operated only to gradually release flood water impounded behind the dam after the crest of flood in the Blackstone River has subsided.

Because these three 48″ x 72″ gates are literally sealed under the spillway, U.S. Army Engineers designed a "bonnetted" type of gate which required extensive engineering before manufacturing could begin. The gates will be subject to a hydrostatic head of 64.5 feet and are designed to operate at 1 foot/minute under these conditions. Electric motor-operated floorstands and control equipment are included in the installation.

As shown in the photo above the gates were completely assembled and operated at the Rodney Hunt plant under the supervision of Army Engineers prior to shipment. This "blue ribbon" procedure was required to insure that the gates met U.S. Army Engineers' design and operating specifications. **The exacting techniques of fabrication which are typical of all Rodney Hunt water control equipment will keep these "blue ribbon" sluice gates operating faithfully for the entire life span of West Hill Dam Project.**

Other phases of this flood control project utilize more familiar Rodney Hunt equipment. Two 60″ x 60″ Rodney Hunt Hy-Q® Sluice Gates are installed in the Worcester Diversion Tunnel on the Blackstone River. For the Woonsocket section of the project, Rodney Hunt supplied a 60″ x 48″ Hy-Q Sluice Gate and a 54″ diameter gate. All gates in these two areas are furnished with portable gasoline engine driven hoist operators.



Owned and Designed by—The Port of New York Authority • Architect-Engineer—Dr. Pier Luigi Nervi

NELSON COMPOSITE BEAMS . . . MUSCLES FOR BUS TERMINAL

This is a model of the two-block-long, three-level George Washington Bridge bus terminal, New York City. Esthetic architectural design provides a "built-in" feeling of movement. Composite Design provides a "built-in" certainty of strength. Composite Design is the "tying" or "bonding" of concrete floor slabs to steel beams by welding Nelson Stud Shear Connectors to the top flanges. When the concrete sets, the three elements act as a unit. This unit is called the Nelson Composite Beam. This design technique helps meet load requirements with shallower, less costly steel beams (or increases strength with the same size beams). It provides longer spans with greater load-carrying capacity per pound of steel. More unobstructed floor space through wider spacing of columns. For information about Composite Building Construction, write to **NELSON STUD WELDING,** Division of Gregory Industries, Inc., Dept. 10, Lorain, Ohio.

GREGORY INDUSTRIES

News Briefs . . .

Water Pollution Control Federation Has Annual Meeting

A tremendous range of problems involved in the efficient and safe disposal of waste—domestic and industrial—was studied at the recent 34th annual meeting of the Water Pollution Control Federation. Over 1,500 leaders in the field attended the meeting, which was held in Milwaukee, October 8-12.

Perhaps one of the most significant messages coming out of the meeting was that there is no one solution to the waste-disposal problem. This point was emphasized in a paper by Richard Billings, administrative assistant to the vice president of manufacturing, Consumer Products Division, Neenah, Wis. He said, "It is not generally understood that there is no universal answer that can be applied to every problem of pollution control. Since there exists no package unit that can be purchased by industry to solve the specific problems of each installation and locality, tailor-made answers must be developed to satisfy the technical and economic requirements of each case." As examples Mr. Billings cited seven tailor-made solutions arrived at for seven different Kimberly-Clark mills.

Frank A. Butrico, F. ASCE, chief of the Office of Resources Development for the U.S. Public Health Service, Washington, urged renewed effort in the field of water pollution control research, in the face of developing problems. "Funds, facilities, and staff must increase at least ten times in the next decade," he stated. He believes that, in addition to increasing funds and resources, there must be a redirection of the research effort. Recent conferences have outlined the research areas needing attention, he said, but when these needs are compared with the research under way, it is clear that a serious void exists.

Our waters are receiving increased loads of pollution because of the rapidly developing urban complex, increased population, and industrial expansion, Gordon E. McCallum, F. ASCE, chief of the U.S. Public Health Service's Division of Water Supply and Pollution Control, said in another paper. "Damage to our waters is manifested by the occurrence of tastes and odors, the killing of fish, and water treatment difficulties," he stated. Warning that possible damage to health may result from the presence of such materials in drinking water, he remarked that already 40 percent of the population of the U.S. is using water that has been used at least once before for industrial or domestic purposes. To meet the pressing need for developing better ways of treating waste waters and, at the same time, recovering usable waters, the Public Health Service has inaugurated an Advanced Waste Treatment Research Program at the Robert A. Taft Center in Cincinnati.

Other familiar figures in the sanitary engineering field dealt with many other disposal and allied problems. Spray irrigation as a feasible means of industrial waste disposal, under certain conditions, was described by Howard G. Luley, M. ASCE, sanitary engineer for the Heinz Company, Pittsburgh. Although ridge and furrow irrigation was probably the earliest organized method of handling municipal waste and has been in use for about 100 years, until recently there has been little information available on it, according to Francis H. Schraufnagel, sanitary engineer for the Committee on Water Pollution of the Wisconsin Board of Health. In some locations, he said, "ridge and furrow irrigation is truly capable of doing a complete job of disposal."

In another challenging paper, entitled "What We Know About Wastes and Pollutants," Gordon M. Fair, F. ASCE, professor of sanitary engineering at Harvard University, emphasized the need for more information on the kinetic aspects of pollution and the ecological responses of varying bodies of water to imposed loads of pollution.

A paper on the economics of sewage treatment, a concern of all property owners, was presented by four leaders in the pollution control field. This paper described new techniques of systems analysis that make it possible to analyze and make preliminary designs of sanitary engineering structures using unit costs and unit efficiencies as an integral part of the design. Dr. John A. Logan, F. ASCE, chairman of the civil engineering department at Northwestern University, was senior author.

During the meeting Harry E. Schlenz, F. ASCE, president of the Pacific Flush Tank Company, Chicago, was elected president of the Water Pollution Control Federation. He will succeed Ray E. Lawrence, F. ASCE, consulting engineer of Kansas City, Mo.

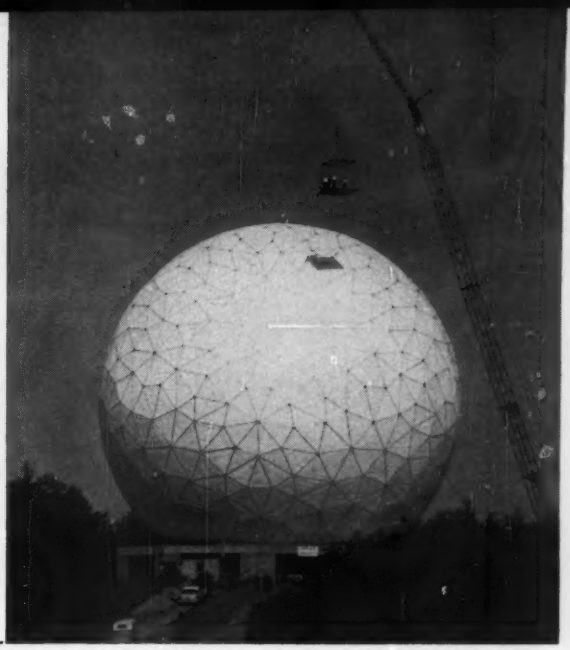
Jack E. McKee, F. ASCE, professor of engineering in environmental health at California Institute of Technology, was elected vice president.

H. Heukelekian, chairman of the Rutgers University Department of Sanitation, and George E. Symons, F. ASCE, consultant and technical editor, Larchmont, N.Y., were made honorary members of the Federation during the annual Awards Dinner. Other honors went to Mark D. Hollis, F. ASCE, Assistant Surgeon General and chief engineer for the U.S. Public Health Service, who was hailed as "one of the truly great leaders of our time in the water pollution control field"; and Samuel A. Greeley, Hon. M. ASCE, Chicago consultant, who received the Charles Alvin Emerson Medal "for his devotion to the highest principles of the sanitary engineering profession." Arthur W. Busch, F. ASCE, and Henry N. Myrick received the Harrison Prescott Eddy Medal.

Placing Concrete for Roof of Bridge Bus Station

First concrete for the unique roof of the $13,000,000 George Washington Bridge Bus Station was placed in an all-day operation on November 1. About 500 cu yd of concrete was placed to form two 92- by 66-ft triangular sections of the roof designed by noted Italian engineer-architect, Dr. Pier Luigi Nervi. The two-block-long, three-level bus station will straddle the depressed twelve-lane George Washington Bridge Expressway between Fort Washington and Wadsworth Avenues. It will be completed in the fall of 1962 by the Port of New York Authority as a part of the lower-level expansion of the bridge. A total of 26 triangular sections will be required to complete the spectacular roof, New York's first example of the work of Dr. Nervi.

Air Force Completes World's Largest Radome



Workers board a platform suspended from a 250-ft crane boom after tightening bolts in the world's largest radome, a 134-ft-high gleaming white sphere. Constructed under direction of the U.S. Air Force's Electronic Systems Division atop a high hill at Tyngsboro, Mass., the structure will house one of the most sensitive research antennas ever built—a 120-ft-dia "dish" designed for global communication and space research. The radome contains more than a million and a half cubic feet of space, and is designed to withstand winds up to 130 mph. It was designed by Massachusetts Institute of Technology's Lincoln Laboratory and built by the H. I. Thompson Fiber Glass Company.

Construction Declines Slightly in October

Construction put in place in October amounted to $5.3 billion, according to preliminary estimates of the Bureau of the Census of the U.S. Department of Commerce. This represented a normal seasonal decline of 3 percent from the September total, but was 5 percent above the October 1960 level.

Spending for private construction in October totaled $3.7 billion, off 2 percent from September but a 6 percent increase over October 1960. Public construction expenditures, at $1.6 billion, were 5 percent less than the September total but 5 percent above last year's level of expenditures.

Spending for all types of new construction in the first ten months of 1961 increased 3 percent to $47.5 billion, compared to $46.3 billion in the same period of 1960. Represented in the ten-month cumulative total was a slight rise in private construction spending and a 6 percent rise in public spending.

New Officers for AGC

Frank F. Burrows, of Belmont, Calif., was nominated for 1962 president of the Associated General Contractors of America, at the midyear meeting of the organization's Governing and Advisory Board, held in New Orleans on October 25. He is now vice president of the AGC and president of Williams & Burrows, Inc., a building contracting firm in Belmont, Calif.

Charles Keller, F. ASCE, president of the Keller Construction Corporation, New Orleans, was nominated for vice president. He has served the AGC in a variety of capacities, and is now chairman of its Labor Committee and a member of the Executive Committee.

Election of these officers will be by mail ballot of the membership, and they will be installed at the AGC's 43rd annual convention in Los Angeles, February 26-March 1.

James D. Marshall, since 1953 executive director of the organization and a leading speaker at the midyear meeting of the Governing and Advisory Board, died in Washington on November 3, a few days after the meeting. He established the AGC's Labor Relations Department and since last May had served on the President's Missile Sites Labor Commission.

William E. Dunn has been appointed executive director. He has been affiliated with the AGC headquarters staff for fourteen years and has been assistant director for six years.

Prizes Awarded for Papers on Arc Welding

Awards totaling $25,000 for papers on progress in arc-welded design of machines and structures are announced by the James F. Lincoln Arc Welding Foundation of Cleveland, Ohio. Awards were presented to 105 designers and engineers.

In the Structures Division, the First Award of $3,000 went to K. E. Dumbauld and D. C. Hoffman. Both are design engineers in the Bureau of Bridges Division of the Ohio State Highway Department, Columbus. The winning paper, "Redesign of a Bridge Superstructure," describes the redesign of the deck and deck girders on a continuous haunched girder bridge. The design reduces cost, field labor, and weight of the superstructure. Cost savings for the superstructure are estimated at $2 per sq ft, a 12.7 percent saving.

The Second Award of $1,500 was given to John F. Orsborn, A.M. ASCE, of the University of Wisconsin, Madison, for his paper, "The Renaissance of Steel Dams." This paper demonstrates that the materials cost of a welded steel dam would be only 75 percent of that required for a concrete dam. Modern design methods based on the use of improved construction materials and arc welding are detailed in the paper.

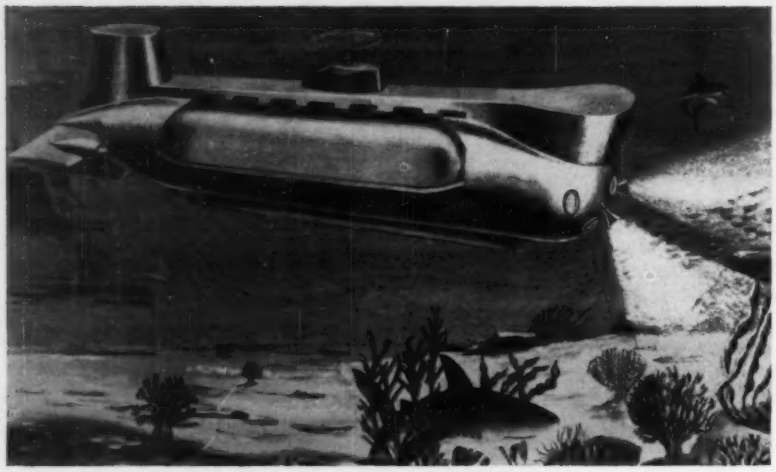
The Third Award of $1,000 was granted to the paper, "Welded Skyscraper," authored by Peter P. Petkoff, M. ASCE, chief structural engineer, and Lin Y. Huang, M. ASCE, senior structural engineer of Minoru Yamasaki—Smith, Hinchman & Grylls, Associated Architects and Engineers, Detroit. The paper describes a welded steel 436-ft-high office building. A feature of the design is the use of unique, butt-welded beam-to-column connections.

The Foundation sponsors an annual Award Program for Progress in Arc Welded Design to advance knowledge and experience in improving the design of machines and structures through most efficient use of arc-welded steel.

NSF to Expand Its Basic Research Program

Additional emphasis will be given to basic research in engineering through the establishment of an Engineering Section within the National Science Foundation. The new Section, which replaces the Engineering Sciences Program office, will consider proposals for basic research in all fields of engineering. In addition to the fundamental engineering sciences such as theoretical and applied mechanics, basic research will be supported in areas of national need, such as fire research and transportation. These programs will be supported in engineering schools throughout the country.

Dr. Samuel Seely, on leave from Case Institute of Technology where he is professor of electrical engineering, heads the new Section.



Aluminum Research Submarine to Explore Ocean Depths

World's deepest-diving submarine and the first ever to be built from aluminum is shown here in artist's drawing. Designed to travel at depths of 15,000 ft, many times below the limit of existing subs, the 50-ft-long "Aluminaut" is being built for Reynold's International by the Electric Boat Division of the General Dynamics Corporation. It will be equipped with sonar, TV cameras, and robot hands to obtain specimens, and will permit man to explore about 60 percent of the ocean floor—most of it for the first time. Separate electrical propulsion systems will give the three-man craft both horizontal and vertical locomotion. Launching is scheduled for 1963. Aluminum was chosen for the submarine because it is three times lighter than steel with greater strength for its weight than other available metals. This permits fabrication of a hull thick enough to withstand tremendous pressures at great depths, yet light enough to stay afloat without external buoyancy. The Wood's Hole (Mass.) Oceanographic Institution will operate the submarine as part of a research program sponsored by the U.S. Navy Office of Naval Research.

Moles Awards Go to Two ASCE Members

Dr. Karl Terzaghi, Hon. M. ASCE, internationally known pioneer in soils mechanics, is the non-member winner, and George F. Ferris, F. ASCE, board chairman of Raymond International, is the member winner of the Moles Award for Outstanding Achievement in Construction. They will receive the organization's annual awards at a dinner, to be held at the Waldorf-Astoria on January 31. They are the 22nd pair to be so honored since the awards were inaugurated in 1941. The Moles is a New York organization of heavy construction and tunnel men.

Dr. Terzaghi, known far and wide as "the father of modern soils engineering," is holder of many honors, including several awards of the ASCE Norman Medal. He has been on the Harvard University and Massachusetts Institute of Technology engineering faculties, and has served on notable construction projects here and abroad. In 1960 the ASCE Soil Mechanics and Foundations Division established an award in Dr. Terzaghi's honor with gifts contributed by his many friends and admirers.

Mr. Ferris was with the Turner Construction Company from 1929 to 1946—for the last five years of this period as chairman of the operating committee for a massive program of air base construction for the Navy in the Pacific. In this capacity he directed a program covering more than $360 million in procurement, shipping, and construction under extremely difficult conditions. Joining the Raymond Concrete Pile Company in 1946, he has been vice president and general manager and president, and in 1960 was made board chairman.

More Than 27 Percent of Interstate System Open

Over 11,250 miles of the 41,000-mile Interstate Highway System are now open to traffic, and construction is under way on another 4,800 miles, according to Federal Highway Administrator Rex M. Whitton, F. ASCE. Information as of September 30, compiled by the Bureau of Public Roads, showed that 1,745 miles of the system had been completed to final standards during the preceding year and that 430 miles were completed during the quarter ending September 30. The mileage open includes toll roads and expressways integrated into the Interstate System.

In addition to the sections open to traffic or under construction, engineering or right-of-way acquisition was in progress on another 10,336 miles. Thus some form of work was under way, or completed, on 26,362 miles—about 65 percent of the 41,000-mile total.

New York Commuter Service to Be Studied

Ford, Bacon & Davis, Inc., New York engineering and management consulting firm, has been selected to study the physical and economic feasibility of routing Jersey Central commuter trains into the Pennsylvania Railroad's Newark station to permit commuters to reach Manhattan via the Hudson Tubes or Pennsylvania Railroad trains. At present, Jersey Central commuters reach New York by ferry from the Jersey Central's rail terminal in Jersey City.

The proposed change in commuter routing calls for the construction of a connecting link between the Jersey Central and Lehigh Valley railroads at Cranford, N.J. The link would permit Jersey Central commuter trains to operate over the Lehigh Valley tracks and then continue on the Pennsylvania line to the Newark Station. The plan would also necessitate rehabilitating the Hudson and Manhattan Railroad and increasing its fleet of cars so that it could serve the additional commuters.

The commuter-service improvement program is aimed at reducing the cost of operating 965 trains and transporting 75,000 suburban passengers daily. Agencies retaining Ford, Bacon & Davis for the study are the New Jersey Division of Railroad Transportation, the Central Railroad Company of New Jersey, and the Pennsylvania Railroad Company.

First Report on AASHO Road Test Is Released

The first of a series of reports on the results of the recently completed American Association of State Highway Officials Road Test is now available, according to an announcement from the Highway Research Board. Engineers interested in a detailed description of the test and its findings are invited to contact the Board (2101 Constitution Avenue, Washington 25, D.C.) for copies of the reports, which will be released intermittently between now and next spring.

The first report, which sells for $2.40, is identified as Special Report 61-A and entitled "The AASHO Road Test: History and Description of Project." It is presented in three chapters. The first is an introduction to the project, outlining its development, purposes and objectives, and the applicability of the findings. The sec-

ond chapter contains general information about the project site, the test facilities, the test traffic, and also outlines the measurements, data processing, and analysis programs. The third chapter describes the experiment designs, layouts and cross-sections; discusses the research studies for pavements and bridges; and includes descriptions of certain associated studies conducted at the test site.

The AASHO Road Test, which was administered by the Highway Research Board, was conducted on specially built test loops near Ottawa, Ill., over a four-year period. It was initiated to determine the behavior of pavement under moving vehicle loads of known magnitude and frequency. Both portland cement concrete and asphaltic concrete pavements, as well as certain types of bridges, were included in the project. The test was the largest and most comprehensive yet undertaken.

San Francisco Seeks to Solve Its Traffic Problem

A comprehensive plan for the solution of the massive traffic problem facing San Francisco commuters—said to be one of the worst in the country—has just been completed for the city by the New York consulting firm of Parsons, Brinckerhoff, Quade & Douglas. The plan, embracing highway, railway, and bus facilities in five California counties, will cost upwards of $1.3 billion. It will be presented to voters at a referendum in June 1962.

If the plan is approved, construction will proceed, in several stages, on the projects involved, including such major engineering structures as an 18,400-ft-long tunnel under San Francisco Bay and a second level for the Golden Gate Bridge, which would carry commuter trains. Despite the emphasis on rapid transit as the solution for the city's traffic problem, the plan does not overlook the motorist. New freeways are an essential part of the planned system.

San Francisco's problem and the proposed solution were described by Walter S. Douglas, partner in Parsons, Brinckerhoff, Quade & Douglas, at the November meeting of the Metropolitan Section.

Tracking Antenna Built in Alaska

The first large X-Y-mounted tracking antenna in this country—designed for 360-deg coverage almost to the horizon—has been built and erected by the Blaw-Knox Company, Pittsburgh, at College, Alaska (near Fairbanks). Scheduled to be ready for operation in the spring of 1962, the new 85-ft-dia antenna will be operated by the Goddard Space Flight Center for the National Aeronautics and Space Administration in support of advanced meteorological satellite projects (Project Nimbus).

Similar tracking antennas are already in use by the Jet Propulsion Laboratory of California Institute of Technology, a research and development facility of NASA, on Project Echo and other experimental space projects. They are located at the Goldstone, Calif., Tracking Station; Woomera, near Adelaide, in south Australia; and Johannesburg, Union of South Africa. These antennas are equatorially mounted to provide coverage of all sky areas above the horizon, except for a small section in the northern hemisphere. In this mounting, the unit's axis is parallel to the axis of the earth.

The Alaskan antenna is similar to other B-K antennas except for the X-Y mounting. The new unit is designed so that one axis is horizontal. With the axis in this position, the antenna is capable of moving through zenith position to all parts of the horizon.

Open-End Runway for Oakland, Calif., Airport

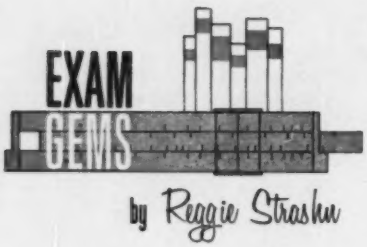
The City of Oakland, Calif., is making a $20 million bid for a share of transcontinental air traffic to the San Francisco area with its current airport expansion program. For many years much of the air traffic has used San Francisco International Airport, just across the bay from Oakland.

In a move to take over part of this business, Oakland has dredged 600 acres out of the harbor to accommodate its enlarged airport that will encompass 1,500 acres when completed. The outstanding feature of the expanded terminal is a unique open-end runway, which is so designed that both ends terminate in San Francisco Bay, permitting both landings and takeoffs over open water. This is expected to reduce considerably the danger of operating in a populous area. Also, with approaches and takeoffs over open water instead of housing or industrial areas, jet noise will be less of a problem.

Work has now passed the halfway mark, and completion is scheduled for April 1962.

Giant Smokestack for TVA Steam Plant

First of two giant smokestacks for the Tennessee Valley Authority's Paradise Steam Plant in western Kentucky nears completion. Workmen are seen adding the final touches 600 ft above ground—45 ft higher than the Washington Monument. Each of the two turbo-generators in the plant will have a capacity of 650,000 kw, the largest ever built, and each will consume over 300 tons of coal an hour. To achieve proper smoke dispersal, each unit will have one of the highest stacks in the world. The stacks are being built by the Custodis Construction Company, Inc., of Chicago, at an overall cost of $482,000. They are made of steel-reinforced concrete and will be lined with brick. Outside diameter is 54 ft at the bottom and 28½ ft at the top. The foundations go 37 ft to bedrock. Concrete is mixed on the ground and hoisted to the working level within the structure, as are the other construction materials. The first stack took eight months to build.



R. ROBINSON ROWE, F. ASCE

EXAMGEM 29, submitted by a correspondent with a question, was a sequence of three tasks, the first being an easy application of Manning's formula to find the discharge of a 20-ft rectangular flume flowing 5 ft deep with n=0.025 and s=0.00147. He found Q=508.5 cfs.

Next in the sequence was the computation for this same discharge of the stage just upstream from a suppressed weir 2.45 ft high "taking the weir coefficient at 3.45." Using Q=508.5, K=3.45, and L=20 in $Q=KLH^{1.5}$, he found H=3.787 and asked, "So what?"

The impertinent question is quite pertinent. Is H the head in the weir, or the drop in water surface, or neither? If H is the head and the weir had been only 1.0 ft high, the upstream stage would have been lower than the unobstructed flow. If H is the drop, the formula wouldn't apply to a small flow with free overfall. So it was neither. But what?

The correspondent added that he had reviewed formulas for submerged weirs without finding one in which 3.45 would be an appropriate coefficient. Basic formulas for free overfall from a still forebay have coefficients ranging from 3.31 to 3.34. If the forebay is flowing, correction must be made for the velocity of approach. Generally this correction is made by increasing H, but for certain standard situations it has been found simpler and sufficiently accurate to increase C. Hence a logical interpretation is that C=3.45 was given to define the regime of this particular weir, including effect of the velocity of approach, but without submergence.

Submerged weir formulas use three other factors: P, the height of the weir; D, the depth of submergence; and Z, the drop in water surface (Fig. 1). The common formulas are more or less independent of free-fall formulas, but that of Bazin is expressed as the ratio if submerged flow to free flow,

$$r = (1.05 + 0.21D/P)\sqrt[3]{Z/H} = m\sqrt[3]{Z/H} \quad \ldots\ldots\ldots\ldots\ldots\ldots (1)$$

in which P=2.45, D=5-2.45=2.55, and hence m=1.2686. Combining this with the free-fall formula and the given K=3.45, and remembering that $Z=H-D$:

$$Q = KLH^{1.5}m\sqrt[3]{Z/H} \quad \ldots\ldots\ldots (2)$$

$$H^7Z^3 = (Q/KLm)^6 \quad \ldots\ldots\ldots\ldots (3)$$

$$H^7(H\text{-}2.55)^3 = 38{,}455$$

$$H = 4.036$$

Adding the height of the weir, the depth of the approach flow is 6.486 ft, corresponding to a mean velocity of 3.92 fps, velocity head of 0.239 ft, and specific energy of 6.725 ft.

(The writer cautions the reader that the Bazin and other well-known formulas were developed for lower stages and diverge at higher stages. Compared to the 6.725, the following have been computed from other formulas: Fteley and Stearns, 6.995; Francis, 6.966; Herschel, 6.946; and King, 6.593.)

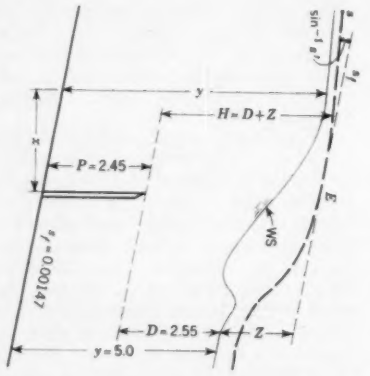


Fig. 1. Elements of submerged weir (slope exaggerated).

Third and last in the sequence was computation of the stage 1,000 ft upstream from the weir. Iteration of the backwater curve is tabulated below, each step determining the distance upstream to an intermediate depth by dividing the change in energy, ΔE, by s', the mean energy gradient relative to the flume gradient of 0.00147. The required depth was 5.789 ft.

Gem quality in this Idaho problem was the casual gift of a weir coefficient which could not be used directly. Those who understood submerged weirs were not misled. A monkey wrench does not gum the works if you can use the wrench.

Table 1. Iteration of the backwater curve above the weir.

y	h_v	E	1,000s	$1000s_m$	1000s'	ΔE	Δx	x
6.486	0.239	6.725	0.700					0
				0.746	0.724	0.265	366	
6.2	0.260	6.460	0.792					366
				0.832	0.638	0.182	285	
6.0	0.278	6.278	0.873					651
				0.920	0.550	0.181	329	
5.8	0.297	6.097	0.967					980
				0.970	0.500	0.010	20	
5.789	0.298	6.087	0.972					1.000

EXAMGEM 30

If the balls simulated compact hardtops, this Kentucky problem would have been a good exercise for traffic engineers:

Two solid balls, each 10 cm in diameter, roll on a smooth level surface toward a head-on collision with elastic impact. Ball A weighing 1,000 g rolled at 20 cm/sec, and Ball B weighing 250 g rolled at 10 cm/sec. Compute their velocities after impact.

Inter-American Sanitary Engineers to Meet in U.S.

For the first time the U.S. section of the Inter-American Association of Sanitary Engineering (AIDIS) will be host to a meeting of sanitary engineers and public administrators of the Americas. The occasion will be the Eighth Congress of AIDIS, set for Washington, D.C., June 10-15, 1962. Sessions will be held in the Departmental Auditorium, Constitution Avenue at 13th Street, and the headquarters hotel will be the Willard at 12th and Pennsylvania Avenue, N.W. All previous AIDIS congresses, held during the fourteen-year history of the organization, have been in Central or South America.

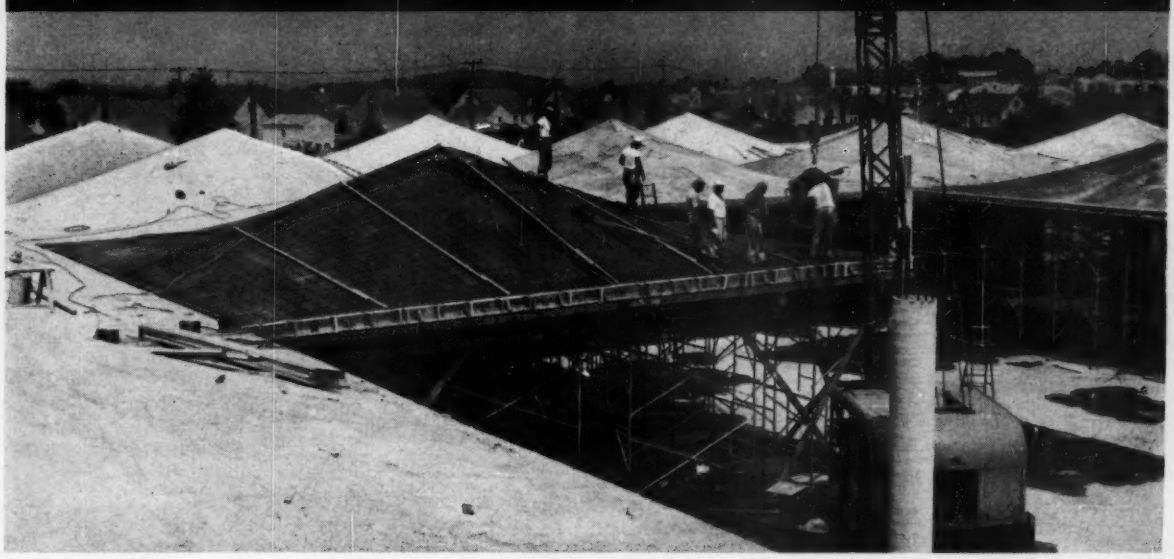
Several hundred prominent sanitary engineers from the Latin American countries are expected to attend, and a simultaneous translation service will ensure the usefulness of the program. The week-long technical program will include sessions on water resources planning; water supply technology; waste water technology; public utilities management; and pollution control (both air and water). The cooperation of the U.S. Public Health Service and the International Cooperation Administration guarantees an outstanding program.

An interesting feature of the meeting will be manufacturers' displays from the various countries of the Americas. Persons interested in exhibiting may write to John G. Stewart, Manager, Water and Sewage Works Manufacturers Association, 165 Broadway, New York 6, N.Y. Information on the congress will be available from Congress Manager Edmund G. Wagner, Office of Public Health, International Cooperation Administration, Washington 25, D.C.

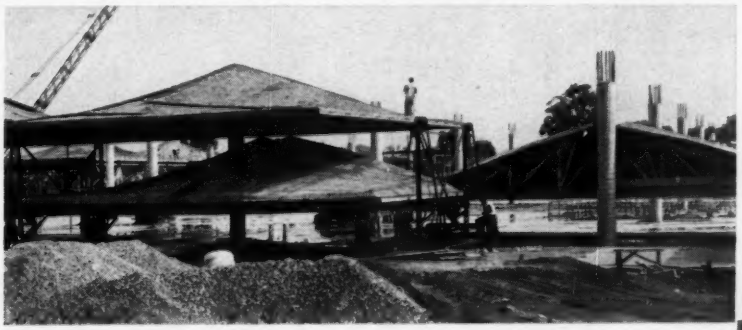
N. Y. Firm to Build St. Paul Post Office

The General Services Administration has awarded a $7,597,000 contract to Electronic & Missile Facilities, Inc., New York, to build a modern six-story Post Office and Custom House addition to the St. Paul Post Office. The project will provide 250,000 sq ft of floor space. It will also provide electronic mail-sorting devices and a new conveyor-to-chute system to further expedite mail handling.

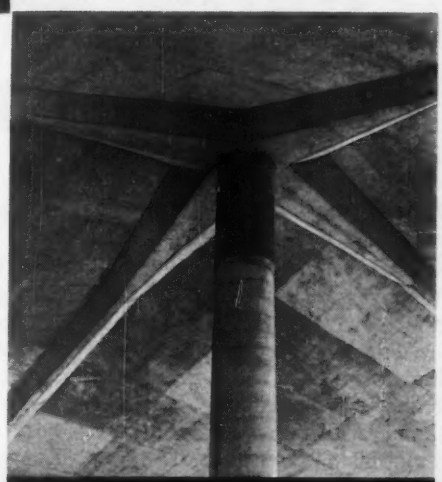
CONCRETE HYPERBOLIC PARABOLOID UMBRELLAS



Workmen place concrete for one of 45 umbrella shells at new Latham, N. Y. shopping center. Each shell is 47′ square, 2½″ thick and weighs 91,500 lbs. Roof exterior received a rough float finish and application of built-up roofing. The completed structure is 236′ x 425′ and provides 100,000 sq. ft. of floor space.



Four sets of forms were used for the entire job. Each form-half weighs 5½ tons and was raised and lowered with simple and efficient rolling jacks. After sufficient curing of the concrete, form-halves were lowered and moved to the next location. Mechanical trades moved in quickly behind the roof crews.



Each umbrella shell is supported by a single 24″ diameter concrete column. Underside of shells will be finished with ¼″ of accoustical plaster applied directly to the concrete. Lehigh Portland Cement was used throughout.

Provide Unobstructed Floor Areas, Distinctive Appearance

New concrete shell roof designs and up-to-the-minute construction techniques make for excellent results on jobs like this shopping center near Latham, N.Y. Here, umbrella-type concrete hyperbolic paraboloids provide large unobstructed floor areas at very low cost.

To help assure themselves of top quality concrete for this interesting job, Machnick Construction Company specified Lehigh Portland Cement. For *your* next job, whether it requires precast or cast-in-place concrete, remember that there is a Lehigh Cement to meet any construction need. Lehigh Portland Cement Company, Allentown, Pa.

Owner: Albany G. E. X. Corporation
Architect: Manuel Morris & Robert E. Sixta Assoc., Kansas City, Mo.
Structural Engineer: Dutton Biggs, Kansas City, Mo.
Contractor: Machnick Construction Co., Inc., Troy, N. Y.
Ready Mix Concrete: Latham Ready Mix, Inc., Cohoes, N. Y.

LEHIGH CEMENTS

concrete wins with maintenance cost

5-year traffic test confirms again the findings of state highway departments and other official tests.

The test was ordered by the Oklahoma legislature to assure taxpayers maximum value for their highway tax dollars. Connecting two-mile sections of concrete and of asphalt, both the best of their type, were built in 1955 on Oklahoma's US 77, a 4-lane, heavily traveled route.

For five years beginning Jan. 1, 1956, exact records were kept of all *pavement* maintenance costs. Total for concrete: $557.82. For asphalt: $1,591.87. And not only did the asphalt cost nearly 3 times as much to maintain during the five years—it is already getting its first resurfacing at an additional cost of $43,753.

Substantial maintenance economy is one reason why concrete is the choice of so many states today—particularly for new Interstate routes.

Engineers are designing concrete pavements to last 50 years and more. It's the one pavement that can be designed *mathematically* to meet specific wheel load requirements. It's the only pavement with beam strength and stability. There is no internal aggregate movement or surface oxidation to shorten life.

The Oklahoma Test Road proves again the long-term value of concrete. The first cost isn't just a down payment. Concrete provides true economy for Interstate highways as well as for other heavy-duty roads.

PORTLAND CEMENT ASSOCIATION

A national organization to improve and extend the uses of concrete

The Oklahoma Test Road north of Oklahoma City will eventually be part of Interstate route 35

on Oklahoma Test Road 65% lower than asphalt!

COMPLETE RESURFACING AFTER ONLY FIVE YEARS ADDS ANOTHER $43,753 TO ASPHALT'S UPKEEP!

Despite continued surface maintenance for five years, the asphalt pavement on the Oklahoma Test Road has deteriorated to the point where complete resurfacing is required. The asphalt sections are being overlaid with 1½ inches of surfacing to seal out moisture and provide a new wearing course. When comparison is made, as shown here, on the basis of *total upkeep* cost, concrete's advantage is dramatic.

CONCRETE

5-year surface maintenance	$557.82
total surface upkeep	$557.82

ASPHALT

5-year surface maintenance	$1,591.87
complete resurfacing	$43,753.00
total surface upkeep	$45,344.87

DECEASED

Alvin Barton Barber (M. '22; F. '59), age 78, who as a member of the Corps of Engineers helped in the reconstruction of San Francisco following the 1906 earthquake, by 1957 when he retired as staff director of the National Resources Board and as a consultant on transportation to the Offices of Defense Mobilization, had an international reputation in the civilian and military transportation fields. The years preceding his retirement from the Army in 1920 with the rank of Colonel were largely spent in Paris, first as a member of the American Railway Commission, and later with Herbert Hoover in the American Relief Administration. Then, in 1922, he returned to the United States, serving from that year until 1948 as manager of the Transportation and Communication Department of the U.S. Chamber of Commerce.

Murray Blanchard (M. '10; F. '59), age 87, whose first professional work was on the locks at Sault Ste. Marie and whose last was as engineer on water works and filtration projects for Chicago, had retired in 1956. His career also included several years each as assistant engineer with the Sanitary District of Chicago, as hydraulic engineer for the State of Illinois, and as consultant in Chicago. Mr. Blanchard served as president of the Illinois Section in 1924.

D. S. Bright (A.M. '13; M. '59), age 77, for almost half a century employed by the Concrete Steel Company of Philadelphia, Pa., headed the firm's Washington, D.C., office for five years, from 1935 to 1940. After military duty as a captain in the Army Ordnance Corps during World War II, Mr. Bright rejoined the firm, remaining there until his retirement in 1954.

Arthur W. Bushell (M. '22; F. '59), age 77, former deputy highway commissioner of Connecticut, had been with that department from 1913 to 1947, serving successively as inspector, division engineer in charge of road and bridge construction, engineer in charge of construction and contracts, chief engineer and deputy highway commissioner and, from 1942 to 1947, consulting engineer on roads and bridges. More recently he was executive secretary of the Connecticut Road Builders Association and the Connecticut Bituminous Concrete Producers Association.

P. W. Clogston (M. '47; F. '59), age 60, during 20 odd years as engineer consultant for several Congressional committees inspected Army and Air Force bases in the United States, Alaska, Europe and North Africa. He was also one of the engineers who helped build the National Gallery of Art in Washington, D.C.

Howard William Duggan (M. '41; F. '59), age 55, from 1933 until his death recently, served the Stebbins Engineering and Manufacturing Company in Watertown, N.Y. He progressed from draftsman to chief engineer and vice president in charge of engineering to his last position as assistant to the president.

Harry Eustance (M. '38; F. '59), age 59, prominent New York State engineer, for the past 15 years had been civil engineering consultant with the Eastman Kodak Company at Kodak Park in Rochester, N.Y., which he joined in 1937. Early in his career he was city engineer of Ithaca, N.Y., for 13 years. A founder of the New York State Water Pollution Control Association, he had been a member of the Irondequoit Planning and Zoning Board of Appeals and a member of the Rochester Planning Commission. Mr. Eustance was a past president of the Rochester Section.

Hyde Forbes (M. '37; F. '59), age 72, nationally known consulting engineering geologist and a leading authority on the geology of California, had been in private practice since 1920. Within his field he specialized in water resources development, land stabilization, tunneling and foundations, serving as consultant to the City of San Francisco since 1935, and at various times the cities of Oakland, Sacramento, Santa Barbara and Riverside as well. He also worked on assignments for the Federal Government during World War II. While attending Stanford University—he graduated in 1913—his interests included drama, and he was a founding member of Ramshead, the campus dramatic society.

Frank G. Fowler (A.M. '07; M. '59), age 90, during his years of construction activity built many miles of highways in New York and Florida. Founder of the Fowler Engineering Company of Mount Kisco, N.Y., in 1897, he subsequently founded the Fowler Construction Company (in 1905) to specialize in highway construction. In his youth, Mr. Fowler worked for the City of New York and supervised the preliminary surveys for Ashokan Dam and Reservoir.

John M. Gardner (M. '42; F. '59), age 76, had been a civil engineer for the Austin Company of Cleveland, Ohio, for 43 years. Although still active with the company—he was serving in Roselle, N.J., as chief estimator—Mr. Gardner had planned to retire in November.

W. Herbert Gibson (M. '12; F. '59), age 84, a retired civil engineer, had been associated with the firm of Gibson and Kline for most of his career. When he retired last January, Mr. Gibson was a partner in the Philadelphia firm.

Edwin Simms Gleason (M. '61), age 59, was a career employee of the Michigan State Highway Department, having joined it in 1923 after graduating from the University of Michigan. Prior to his last promotion in 1958 to engineer of design, Mr. Gleason held the posts of estimating engineer and engineer of bridge design.

Ralph Dickinson Goodrich (M. '16; F. '59), age 83, although he retired in 1948 as dean of the College of Engineering at the University of Wyoming, served from 1950 until 1956 as chief engineer for the Upper Colorado River Commission, and since 1956, as a private consultant. His career spanned 54 years, the major portion of which was devoted to water development projects and education, and included such contributions to engineering as the variable radius arch dam, which he developed in 1913, and the graphical-step method of flood routing in 1931.

Howard Edgar Irby (A.M. '52; M. '59), age 35, from 1954 until his death was associate professor at the University of Missouri in Columbia. Past professional affiliations included several years as instructor with the University of Oklahoma, and an additional three years with the Tulsa, Okla., consulting firm, W. R. Holway & Associates, as senior design engineer.

Miles I. Killmer (M. '24; F. '59), age 78, was a tunnel engineer who during a successful career worked on many important projects, including the Brooklyn-Battery and Holland tunnels in New York. He was a vice president and director of the Mason and Hanger-Silas Mason Company in New York, and held a patent on a time-saving and safer method of tunnel construction under rivers. Mr. Killmer was recipient in 1946 of the Moles Award for outstanding achievement in construction.

Lewis McDonald (M. '42; F. '59), age 77, when he retired in 1954 was in his forty-fourth year with the Chicago Bridge and Iron Company. From 1921 to 1931 he was manager of the company's Chicago sales district and before his election to the vice presidency in 1946 served as assistant to the board chairman. Very early in his career for a two-year period he was a civil engineering instructor at his alma mater, the University of Illinois.

Donald F. Noyes (M. '26; F. '59), age 73, in 1929 became vice president of the W. S. Lee Engineering Company, and in 1949 retired from that office. Formerly, while employed by the Duke Power Company, he worked at Marion, N.C., on the preliminary surveys for hydroelectric installations on the Catawba River.

Thomas L. Pierce (M. '52; F. '59), age 70, was project director for the third House Office Building in Washington, D.C. He began his engineering career with the Wilmington (Del.) Park Commission in 1912 and in 1936 joined E. I. du Pont de Nemours & Company, Inc., retiring as dean of the construction superintendents in the firm's engineering department nearly 20 years later. From there he joined the Office of the Architect

(Continued on page 104)

of the Capitol in 1956, becoming director in charge of supervision of the House Office Building, then in the planning stage.

Marshall Reynolds (M. '61), age 42, became a member of Thomas B. Bourne Associates, Inc., in 1949. He began there as a resident engineer with responsibility for the design of improvements to the Kimpa airfield in Seoul, Korea, followed by similar employment on major military airfields in Japan. He was later project manager and designer at Saigon International Airport in Viet-Nam, and then, in 1960, resident engineer at the Fairbanks International Airport in Alaska. Mr. Reynolds was last employed as manager of the firm's Honolulu office.

Frank Carter Squire (M. '23; F. '59), age 76, retired, initiated his career in railroad engineering in 1907 with the Oregon and Northwestern Railroad Company as assistant engineer. In later years he served as engineer of the western group on the President's Conference Commission on Railroad Valuation, as valuation engineer for the Association of American Railroads, and, from 1943 to 1955, as a member of the Railroad Retirement Board.

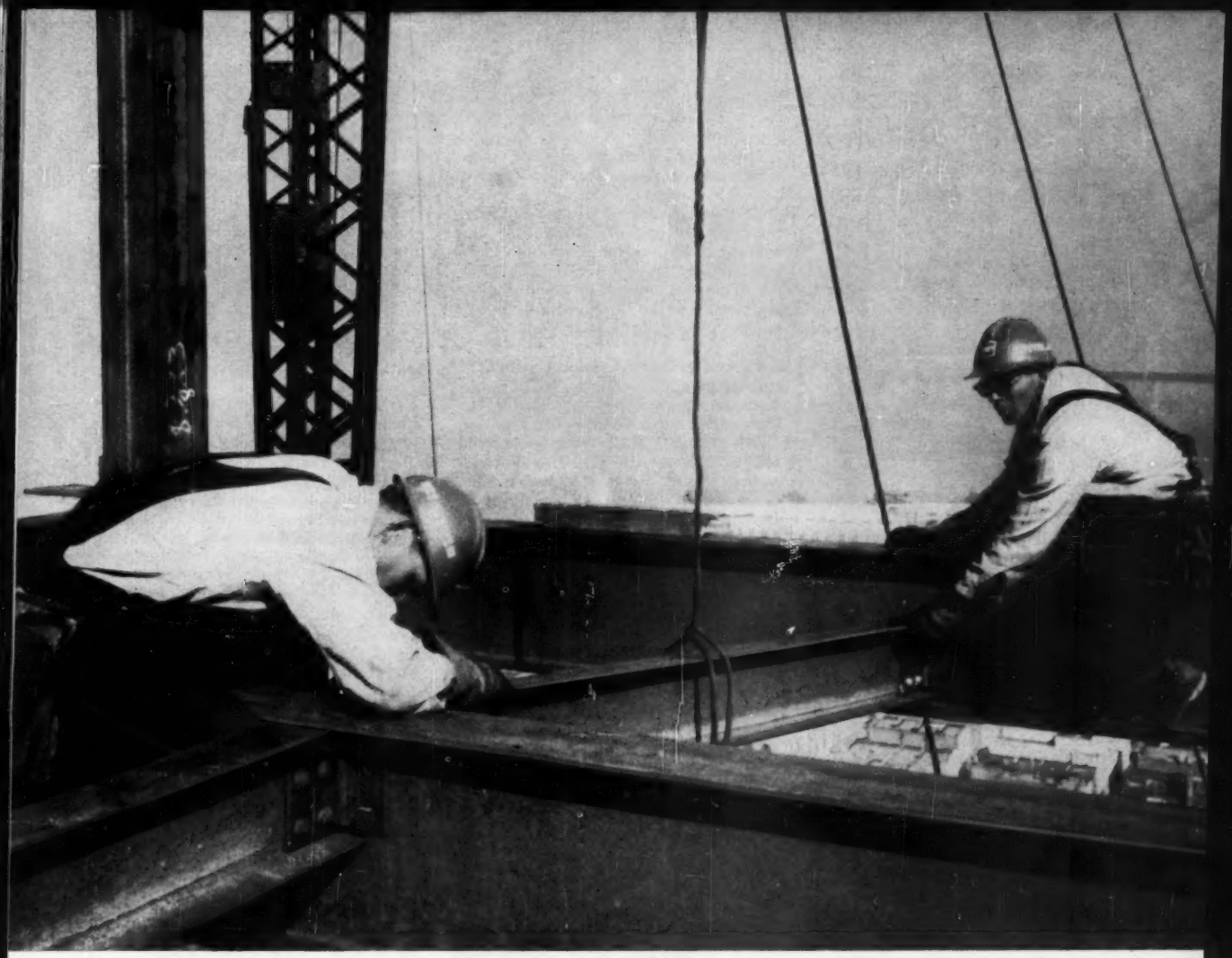
Ralph Koch Thompson (J.M. '55; A.M. '59), age 28, was an ensign in the U.S. Navy. He had previously graduated from Princeton University with a bachelor's degree in engineering.

William F. Turner (M. '28; F. '59), age 77, was a former chief of the Southern Pacific Railroad's Sacramento Division. He joined the railway company in 1906 and was immediately assigned to repair the line between San Francisco and Los Angeles, damaged in the 1906 earthquake. He subsequently became acting division chief in Ogden, Utah; division engineer in Tucson, Ariz.; and, in 1923, Sacramento Division chief, a job he held until his retirement in 1954.

Fred W. Whiteside (M. '15; F. '59), age 85, was a Denver consulting engineer who started his career by being the first engineering graduate of the University of Colorado in 1897. After working as an assistant engineer with the Denver & Rio Grande Railroad and the Colorado Fuel & Iron Corporation Mr. Whiteside was chief engineer for the Victor-American Fuel Company for 35 years. Although, as a consulting engineer he had specialized in recent years in the field of coal mining, Denver's residents also remember him as the builder of nearby Marston Reservoir.

Harry A. Wistrich (A.M. '27; M. '59), age 66, was a retired chief engineer of the Lehigh Valley Railroad Company. He joined the railroad in 1921 as a draftsman and, on his way up to chief engineer, was for many years bridge designer.

Michael A. Yoder (J.M. '56; A.M. '59), age 28, a 1956 graduate of the University of Arizona, was a service engineer with the Western Precipitation Corporation in Metuchen, N.J., when he died recently. He had been with the firm in that capacity since his graduation.

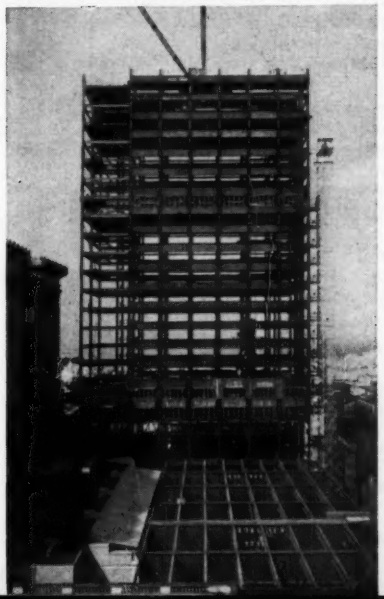


29-story hotel addition high-strength bolted

. . . quickly and quietly

Steel
for Strength
. . . Economy
. . . Versatility

Architect: Mario Gaidano;
structural engineer: H. J. Brunnier;
general contractor: Haas and Haynie Corp.;
fabricator and erector: Bethlehem Steel.



This 29-story tower addition makes the Fairmont San Francisco's tallest hotel. A total of 92,100 Bethlehem high-strength bolts were used to make field connections of its earthquake-resistant, 3,089-ton steel frame.

BOTHERSOME NOISE ELIMINATED

And during the bolting, the Fairmont was one of San Francisco's quietest hotels, too. Eliminated was the noisy chatter of riveting guns.

HIGH-STRENGTH BOLTING IS QUICK, TOO

More and more people . . . owners, structural engineers, and architects . . . are specifying high-strength bolting. It's simple, faster than other methods, and involves smaller crews.

LATEST INFORMATION AVAILABLE

Up-to-date facts on high-strength bolting can be obtained by calling the nearest Bethlehem office. Or write to us in Bethlehem, Pa.

BETHLEHEM STEEL COMPANY, BETHLEHEM, PA.
Export Sales: Bethlehem Steel Export Corporation

BETHLEHEM STEEL

BETHLEHEM STEEL

News of Members *(Continued from page 27)*

Theodore E. Veltfort, nationally prominent trade association executive who has served in engineering, finance, accounting, statistics and general business operations for the past 50 years, has been named chairman of the American Standards Association's Sectional Committee A119. Currently, he is serving as managing director of the Copper and Brass Research Association in New York.

Edward J. Quirin, president and chairman of Frederic R. Harris, Inc., of New York, has been named president of the company's new Philadelphia affiliate, Harris-Dechant, Inc., which replaced Harris-Dechant Associates. As a result of this change, the long partnership between the Harris firm and **Frederick H. Dechant,** who has been named chairman of the board of the new affiliate, will continue under a closer form of association. Serving as consultant is **Samuel Rosenberg,** former project manager with Frederic R. Harris, Inc.

Roger M. Hansen has been promoted from structural design engineer to chief draftsman of the Worden-Allen Company, a structural steel fabricating firm in Milwaukee, Wis., which he joined last June after receiving his masters degree from Lehigh University. While attending Lehigh, Mr. Hansen was research assistant on the large bolted joints project conducted by the University's Fritz Engineering Laboratory.

John T. O'Connor, from 1957 to 1961 a graduate research assistant at the Johns Hopkins University, is currently assistant professor of sanitary engineering at the University of Illinois. He received his doctorate from Johns Hopkins in October, his dissertation dealing with the absorption of radioactive zinc on river silts. Part of this time, from 1959 to 1960, Professor O'Connor also held a U.S. Public Health Service Research Fellowship.

David C. Sims has rejoined the Pennsylvania Department of Highways as a member of the urban coordinator's staff after eight years with the Boston consulting firm of Fay, Spofford and Thorndike, Inc. His previous assignment with the Department, from 1949 to 1953, was as senior design draftsman and resident engineer in the Franklin district office.

Thomas H. Campbell, newly appointed acting executive officer of the Department of Civil Engineering at the University of Washington, is relieving **Robert B. Van Horn,** who is retiring after serving as department head for 20 years. Professor Campbell first joined the Washington faculty in 1945 after teaching for seven years at the University of Alaska, followed by several years' service in the U.S. Army. In addition to the 37 years he has been at the University, Professor Van Horn early in his career was with the U.S. Reclamation Service.

Some Basic Facts About High-Early Strength Concrete

What It Is

The simplest explanation of what is generally called "high-early strength" in concrete is a comparison of the strength of concrete made with Hi-Early (Type III) cement to that of concrete made with Regular (Type I) cement. Approximate relative strengths are shown in the table below. One point that should be kept in mind in such a comparison is that *compressive strength is not always the best measurement of concrete quality*. For instance, the highest strength concrete is not always the most durable. Many other factors also have to be considered although strength is the most commonly used yardstick for job-site quality control.

Relative Strengths of Concrete Made From Hi-Early (Type III) and Regular (Type I) Cements

	Compressive Strength	
	3 Days	28 Days
Regular Cement (Type I)	100%	100%
Hi-Early Strength Cement (Type III)	190%	130%

(Above comparisons do not apply when steam curing is employed)

Tabulation courtesy of "Guide to Better Field Practice", Concrete Construction.

In this tabulation the strength of concrete made with Regular (Type I) cement was used as 100%. It can easily be seen how concrete made with Hi-Early cement gains strength rapidly in the early stages, and how this advantage wanes in the later stages.

When to Use High-Early Strength Concrete

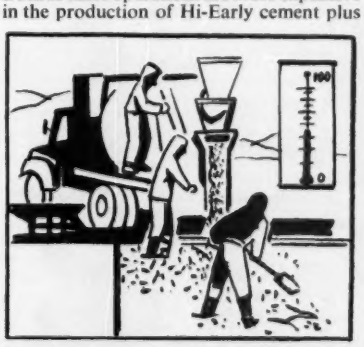
This decision is usually made on the basis of economics. High-early strength concrete is generally used where high strengths at early ages are necessary. Since the production of high-early strength concrete is more expensive, its convenience must offset the additional cost. The factors that determine whether high-early strength concrete is needed or desirable are usually early stripping of forms, early *use* of concrete such as heavily traveled pavements or floors and the necessity for shorter curing periods during cold weather to develop strength to resist freezing at early ages. High-early strength concrete can be produced by using Hi-Early cement or by increasing the cement factor if regular cement is used—more about this later.

For emergency jobs to provide fewer interruptions during remodeling or repairs, high-early strength concrete is often specified.

Earlier form removal is one advantage of using high-early strength concrete.

Why Hi-Early Cement Costs More

Two of the most expensive operations in the production of cement are the burning and preparation of clinker and the grinding of the clinker into finished cement. Both of these operations are more expensive in the production of Hi-Early cement plus additional costs in changing raw material proportions and raw material preparation. These factors account for the increased production costs of Hi-Early cement and its higher price.



When low temperatures are expected at early ages, high-early strength concrete shortens the period of curing and possible freezing damage.

Is Hi-Early Cement Necessary to Get High-Early Strength Concrete?

When a limited amount of high-early strength concrete is needed, it may prove expensive for a concrete producer to stock Hi-Early (Type III) cement for the job. In such a case, he might consider using larger quantities of Regular (Type I) cement to obtain the necessary early strength.

In this event, advance tests of the materials to be used in the job should be made to determine how much cement per yard will be required. To give approximations of what to expect, Alpha's research men did some preliminary testing for comparison. (Several brands of cement were used.) These are the "rules of thumb" resulting from the tests:

1. In general, the strength of relatively *lean* 5 sacks per yard Type III cement concrete can be duplicated at *1 and 3* days by using Type I cement if the cement factor is increased 2 sacks per yard to a 7-sack mix.
2. The strength of *richer*—6 sacks or more—Type III cement mixes can be duplicated at *1 and 3* days with Type I cement by increasing the cement factor by about 2½ sacks per yard to an 8½-sack mix.
3. At 7 days, the strength advantage of Type III concrete becomes less than at earlier ages. To maintain equal strengths of the concrete at 7 days, the cement factor for Type I cement would have to be increased by about 1½ sacks per yard over that of Type III cement.

It can thus be seen that it is easier to duplicate Hi-Early cement concrete strength at 7 days than at the earlier 1 and 3 days.

When Hi-Early cement is used for concrete products (block, precast beams, etc.) there are many other variables to be considered such as aggregates, steam curing and others. Alpha Field Engineers are equipped and ready to help users of our cements achieve maximum efficiency from any application of portland cements.

New Publications

Engineering research . . . . Over 11,000 research projects with a value of $180 million are summarized in the 1961 edition of the "Engineering College Research Review." This biennial publication of the Engineering College Research Council records almost all research being done in U.S. engineering colleges. It sells for $4.00 and may be obtained from Prof. W. Leighton Collins, Secretary, American Society for Engineering Education, University of Illinois, Urbana, Ill.

Traffic control . . . . Availability of a new "Manual on Uniform Traffic Control Devices for Streets and Highways"—the first complete revision since 1948 of standards for the design and application of signs, signals, and markings—is announced by the National Joint Committee on Uniform Traffic Control Devices. The 333-page volume is well illustrated, with devices shown in their proper colors. Copies, priced at $2.00 each, may be ordered from the U.S. Government Printing Office, Washington 25, D.C.

Highway engineering, California . . . . A comprehensive examination of devices used to guard against erosion from streams, rivers, and surf has recently been completed by the California Department of Public Works. The results of the research, design, and field studies are reported in a 423-page volume entitled "Bank and Shore Protection in California Highway Practice." The report is extensively illustrated, and a bibliography of 250 references is appended. Copies may be ordered from the Printing Division, Documents Section, North 7th Street and Richards Blvd., Sacramento 14, Calif. The price postpaid is $3.00 in the U.S. ($3.12 to Californians) and $3.50 elsewhere.

Weather modification . . . . What the U.S. is doing in the field of weather modification is summarized by the National Science Foundation in a publication entitled "Weather Modification, Second Annual Report, 1960." During 1960 the Foundation expended $1.4 million in a program aimed at altering and improving weather. The bulletin is for sale by the U.S. Government Printing Office, Washington 25, D.C., at 15 cents.

Sedimentation studies . . . . Results of the design, development, and testing of three differential pressure gages for remote measurement of suspended sediment concentration in streams are reported by the Federal Inter-Agency Sedimentation Project at St. Anthony Falls Hydraulic Laboratory. The publication, identified as Report P, is available from the U.S. Corps of Engineers, 1217 U.S. Post Office and Custom House, St. Paul 1, Minn. The cost is 50 cents per copy, payable to the Treasurer of the United States.

Highway directory . . . . Names and addresses of more than 2,000 key administrative engineers and officials for the 50 state highway departments are listed in the 1961 edition of the pocket-sized directory, "Highway Officials and Engineers," published annually by the American Road Builders Association. The directory also includes administrative personnel of the Bureau of Public Roads. Orders, accompanied by $1.00, should be sent to the American Road Builders Association, World Center Building, Washington 6, D.C.

Welded design . . . . Both students and practicing engineers will find in "Design of Welded Structural Connections" the fundamentals that will enable them to design efficient welded connections for all types of structures, once the forces and moments are known. The reference provides information on the arc-welding process, the weldability of structural steels, distortion, the design of connections by both the elastic and plastic theories used in buildings and bridges, erection, welding to existing structures, and inspection. The authors are Omer W. Blodgett and John B. Scalzi, Fellows ASCE. The reference is available from the James F. Lincoln Arc Welding Foundation (Cleveland 17, Ohio) at $1.00 a copy in the U.S. and $1.50 elsewhere.

Palisades project . . . . Issuance of a new Bureau of Reclamation Record of Design and Construction, "Palisades Dam and Power Plant," is announced by Assistant Commissioner Grant Bloodgood. The 535-page publication records the planning, design, construction, and initial operation of Palisades Dam and Power Plant, principal features of a Bureau of Reclamation project in eastern Idaho. The 270-ft-high dam is a large earthfill structure, and the plant has a capacity of 114,000 kw. Copies of the record, priced at $10 each, may be obtained from the Assistant Commissioner, Attention Code 841, Bureau of Reclamation, Building 53, Denver Federal Center, Denver 25, Colo.

Research, government . . . . A new Selective Bibliography, listing U.S. Government research reports, foreign translations, and other technical documents on the problems and effects of air pollution and methods and equipment for purification, has been published by the Office of Technical Services. The bibliography, entitled "Air Pollution and Purification" and identified as SB-448, may be purchased for 10 cents from the Office of Technical Services, Business and Defense Services Administration, Washington 25, D.C.

Materials testing . . . . The official record of the American Society for Testing and Materials for 1960 is now available in the recently issued ASTM Proceedings. The 1242-page volume, which includes 77 committee reports and 44 technical papers dealing with research and standards for materials, provides an invaluable reference. Copies, at $12.00 each, may be ordered from the American Society for Testing and Materials, 1916 Race Street, Philadelphia 3, Pa.

Housing, research . . . . The requirements of a national program of urban research are outlined in a study prepared by Resources of the Future, Inc., 1775 Massachusetts Avenue, N.W., Washington 6, D.C. The 36-page report, entitled "A National Program of Research in Housing and Urban Development," was made at the request of Robert C. Weaver, Administrator of

the Housing and Home Finance Agency. It sells for 50 cents and may be ordered from Resources for the Future, Inc., 1775 Massachusetts Avenue, N.W., Washington 6, D.C.

Pollution control . . . . Increasing concentrations of copper in water and sewage pose problems in sewage treatment. These problems are discussed in a publication of the New England Interstate Water Pollution Control Commission prepared by Wesleyan University's Industrial Waste Laboratory. Inquiries regarding the study —entitled "The Occurrence of Copper in Water, Sewage, and Sludge and Its Effect on Sludge Digestion"—should be addressed to the New England Interstate Water Pollution Control Commission, 73 Tremont Street, Boston 8, Mass.

Building maintenance . . . . The tremendous importance of maintenance and repair of structures—nearly $20 billion is spent for these purposes in the U.S. annually—was the subject of a 1960 spring conference sponsored by the Building Research Institute. The proceedings of the conference are now available in a brochure entitled "Performance of Buildings." Identified as Publication 879, the Proceedings sell for $5.00 and may be ordered from the Building Research Institute, Division of Engineering and Industrial Research, 2101 Constitution Avenue, Washington 25, D.C.

Roads, tropical . . . . Availability of a bibliography (in English) on "Road Problems in Intertropical Countries, Especially Africa" is announced by the Centre de Documentation Economique et Sociale Africaine. More than 900 references are included in the Bibliography, which sells for 200 francs a copy. Orders should be sent to the Centre de Documentation Economique et Sociale Africaine, 42 Rue du Commerce, Brussels, Belgium.

Highway research . . . . Research findings from a variety of experimental projects and studies in the highway and allied fields are reported in recent publications of the Highway Research Board (2101 Constitution Avenue, Washington 25, D.C.), from whom they may be ordered. Bulletin 271, entitled "Increasing Traffic Capacity of Arterial Streets," sells for $1.60; Bulletin 275, devoted to "Concrete Quality Control, Aggregate Characteristics, and the Cement-Aggregate Reaction," sells for $1.40; Bulletin 277, dealing with "Non-Destructive Dynamic Testing of Soils and Highway Pavements," is $1.60; Bulletin 279, entitled "Bridge Design Studies and Piling Tests, 1960," sells for $1.80; Bulletin 280, on "Bituminous Construction Operations," is 60 cents; Bulletin 283, entitled "Influence of Stabilizers on Properties of Soils and Soil-Aggregate Mixtures," is $3.40; Bulletin 286, on "Drainage Structures: Design and Performance, 1960," sells for $1.00; Bulletin 288, dealing with "Land Use and Development at Highway Interchanges," is $1.80; and Bulletin 289, detailing "Flexible Pavement Design Developments: 1961," sells for $2.00.

Engineering geology . . . . Publication of a series of review volumes in engineering geology is planned by the Geological Society of America (419 West 117th Street, New York 27). Volume 1, edited by Thomas Fluhr and R. F. Legget, is now off the press and may be ordered from the Geological Society at $7.00 a copy. It contains eight papers covering the following fields: Petrography applied to portland-cement concrete; photoanalysis and interpretation in engineering geology; sand and gravel; engineering geology of radioactive waste material; rock bolting; engineering seismology; recent USSR publications in selected fields of engineering soil science; engineering aspects of sediment transport.

Technical writing . . . . "Writing Better Titles and Abstracts" is the title of a helpful publication for technical authors. Issued as Bulletin 254 of the Washington State Institute of Technology, the publication aims to prove that "technical writing can be interesting" and that good titling and abstracting are essential elements of effective writing in the field. John D. Stevens, technical editor of the Institute of Technology, is the author. Free copies are available from the Office of Technical Extension Service, Dana Hall, Washington State University, Pullman, Wash.

Power . . . . The Society's Kansas City Section has sponsored several annual technical conferences of wide community interest. Proceedings of the November 1960 conference, which was centered about the topic, "Progress in Power," covers many aspects of power generation—steam, electric, hydroelectric, and nuclear. Inquiries about the Proceedings should be addressed to the Secretary of the Kansas City Section, William R. Gibbs, 1500 Meadow Lake Parkway, Kansas City 14, Mo.

Wood trusses . . . . In "Determination of Member Stresses in Wood Trusses with Rigid Joints," Stanley K. Suddarth presents a method for theoretical analysis of stresses and deflection in wood trusses with rigid joints. The results compare well with those obtained from experiments with three separate types of truss-load combinations. The reference has been issued by the Wood Research Laboratory of Purdue University as Research Bulletin No. 714. Inquiries should be sent to Purdue University, Agricultural Experiment Station, Lafayette, Ind.

Protective painting . . . . Issuance of the annual report of the Steel Structures Painting Council is announced by the Council. The work of the Council includes definitive evaluations of the steel-protective products and processes developed in recent years by the paint and plastics industries. Work done in the past year includes research and testing of steel surface preparation, protection for water immersion, painting of welds, and products for use on rusty steel, as well as bridge and tank painting in shop and field. Inquiries should be addressed to the Steel Structures Painting Council, 4400 Fifth Avenue, Pittsburgh 13, Pa.

Underground construction . . . . Engineers concerned with the design and construction of underground installations will be interested in a recent Corps of Engineers' manual, identified as EM 1110-345-432. Inquiries about the manual, entitled "Design of Underground Installations in Rock Tunnels and Linings," should be addressed to Col. W. P. Leber, Officer of the Chief of Engineers, Washington 25, D.C.

Water resources . . . . Papers from the 1960 Western Resources Conference, held at the University of Colorado in August 1960, have been published by the University Press under the title, "Water: Measuring and Meeting Future Requirements." The compendium covers new calculation techniques, novel approaches to water-use patterns, and comprehensive surveys of work in special areas. Copies may be purchased from the University of Colorado Press (Boulder, Colo.) for $3.50.

Technical writing . . . . The fine points of technical writing are covered in a recent publication of the American Technical Society, entitled "Handbook for Technical Writers." The authors, R. C. Tracy and H. L. Jennings, examine in detail the report-writing function and give detailed instructions for dealing with format, style, and mechanics of preparing reports. Preparation of documents originating with government agencies and contractors receives primary attention. Copies of the reference, priced at $3.50, are available from the American Technical Society, 848 East 58th Street, Chicago 37, Ill.

Soil mechanics . . . . A valuable source book in the field of construction compaction has been issued by the Highway Research Board. The reference includes a wealth of material on performance characteristics of various types of compactors, methods used to maintain control of moisture content and density, and the results of numerous compaction experiments involving various types of soil and equipment. The 254-page publication—entitled "Factors That Influence Field Compaction of Soils" and identified as Bulletin 272—may be ordered from the Highway Research Board, 2101 Constitution Avenue, Washington 25, D.C., for $4.00 a copy.

Prestressed concrete . . . . Durability and behavior of prestressed concrete beams are studied in Technical Report No. 6-570 recently issued by the U.S. Army Engineer Waterways Experiment Station. The investigation comprised the fabrication and testing of 28 large prestressed concrete beams and 412 small auxiliary specimens of the same concrete to obtain information on the factors affecting durability of prestressed concrete beams. Copies of the report, priced at 75 cents each, may be obtained from the Director of the Waterways Experiment Station, Vicksburg, Miss.

Positions Announced

Public Health Service. Competitive examinations for appointment of Sanitary Engineers in the Regular Corps of the Public Health Service will be held February 13-15, 1962, for Junior Assistant applicants, and February 13-16, 1962, for Assistant and Senior Assistant applicants. Candidates must be U.S. citizens, possess a master's degree in sanitary science and public health, or equivalent experience above the bachelor's degree. Applications are available from the Surgeon General, U.S. Public Health Service (P), Washington 25, D.C., or from field stations of the PHS, and must be filed by January 5, 1962.

U.S. Army Corps of Engineers. The Corps' Baltimore Engineer District has openings for professional engineering personnel, for the design and construction of hospitals, laboratories, barracks, airfields, flood control works, and river and harbor projects. Openings are for a Structural Engineer, GS-12 ($8,955); Architectural Engineer, GS-9 ($6,435); several Civil Engineers, on the GS-11 and GS-12 levels (from $7,560 to $8,955); Supervisory Hydraulic Engineer, GS-12; Structural Engineer, GS-9; Construction Management Engineer, GS-11; and Architect, GS-11. Applicants should contact the Personnel Branch, U.S. Army Engineer District, 24th Street and Maryland Avenue, Baltimore 18, Md.

Applications for Admission to ASCE, Sept. 30-Nov. 4, 1961

Applying for Member

Ludwig Anselmini, New York, N. Y.
Ignacio Arango-Alvarez, Colombia, South America
Clayton Campbell Armstrong, Philadelphia, Pa.
Henry Nash Babcock, Old Greenwich, Conn.
Bernard Edward Behrends, Springfield, Ill.
John Ward Beretta, San Antonio, Texas
Louis Michael Bini, Santa Clara, Calif.
Roy Bremer, Baghdad, Iraq
Gerald Joseph Caspary, Houghton, Mich.
Dino Tullio Cassinelli, San Francisco, Calif.
Frank Schneider Connole, Altus, Okla.
Leonidas Siqueira De Amorim Nascimento, Philadelphia, Pa.
Carson Freyman Diefenderfer, Bethlehem, Pa.
Frank Irving Dorr, Jr., New York, N. Y.
Walter Robinson Douglas, Lima, Peru
Harold O'Donald Ellefson, Los Angeles, Calif.
James Stephen English, Jacksonville, Fla.
Roy Curtis Fleming, Kingsport, Tenn.
Harold Hugo Franke, Moorestown, N. J.
James Stewart Gillen, Garden City, N. Y.
Herman Gray, Nashville, Tenn.
Harold Harding Heidrick, Millbrae, Calif.
Emil Charles Hervol, Boston, Mass.
John Lemuel Hodges, Jr., Arlington, Va.
Burt Vincent Janes, Chicago, Ill.
Clifford Hyrum Jex, Grand Junction, Colo.
Richard Henry Kermode, Los Angeles, Calif.
Ahmed Omer Khalafalla, Khartoum, Sudan
Muammer Kitapci, Cincinnati, Ohio
Millard Franklin Kirk, Baltimore, Md.
Cecil Murry Langford, Nagoya, Japan
Bernard Arthur Leach, London, England
Arthur Frank Lehmann, Harrisburg, Pa.
James Emanuel MacDonald, Braintree, Mass.
Rolland William Marino, Jr., Los Angeles, Calif.
Peter Felix Mattei, St. Louis, Mo.
John Edward Maulding, Downey, Calif.
Arthur Colbern Michaels, Memphis, Tenn.
Clarence Joseph Montgomery, Jr., Houston, Texas
Korkut Ozal, Ankara, Turkey
John Blythe Parkinson, Cheshire, England
James Paull, Los Angeles, Calif.
Raymond Pennotti, River Edge, N. J.
Jose Bernardo Perez Guerra, Caracas, Venezuela
Ray Franklin Perry, Rolla, Mo.
Nilakanta Sivathanu Pillay, Columbus, Ohio
Jack Parker Pollock, Washington, D. C.
John Hubert Redding, Rosemere, Quebec, Canada
Richard Eric Reinke, Atlanta, Ga.
Robert Harold Renwick, Ottawa, Ill.
Harold C. Riches, Jr., Richland, Wash.
Hanumantha Sanjeevi, Chicago, Ill.
Navinchandra Ambalal Shah, Madison, Wis.
Walter David Shapiro, New York, N. Y.
William Shofnos, Washington, D. C.
Peter Albert Sison, Columbus, Ohio
Richard Crofton Sloan, Vicksburg, Miss.
Albert Marshall Solomon, Woodland Hills, Calif.
Colin Maynard Spence, Durban, Natal, South Africa
Charles Harold Stallings, Jr., Mobile, Ala.
Einar Svensson, Seattle, Wash.
Moncef Thraya, Tunis, Tunisia
Joseph Thomas Raymond Pierre Touzin, Montreal, Quebec, Canada
Richard Calvin Tucker, Newport, Wash.
Charles Gaylord Van Dine, Ft. Polk, La.
Subramonian Unni Vasudev, Ithaca, N. Y.
Jan Van't Veer, Maracaibo, Venezuela
Thomas Joseph Walsh, San Francisco, Calif.
John Arthur Wilson, Jr., Natick, Mass.
Robley Winfrey, II, Englewood, Colo.

Applying for Associate Member

Abdullahi Mohammed Ali, Damazin, Sudan
Gary Anderson, Fort Worth, Texas
Howard Wilson Anderson, Nashville, Tenn.
Paul Theodore Anderson, San Francisco, Calif.
Henry Carl Bain, San Antonio, Texas
Shankha Kumar Banerji, Urbana, Ill.
William Edward Baker, Columbus, Ohio
Elie Abcar Bannayan, Beirut, Lebanon
Joseph Martin Brown, Miami, Fla.
Michael Louis Burke, Lansing, Mich.
Enrique Camargo De La Torre, Bogota, Colombia
Shrikrishna Vishnu Chitale, Poona, India
Miguel Angel Clare, Panama City, Panama
Ronald Leonard Cook, Madison, Wis.
James Paul Dean, Kingston, Ontario, Canada
Robert Stanley Drupieski, Albany, N. Y.
Gerald Eugene Engdahl, Chicago, Ill.
Kenneth Lee Evans, Baltimore, Md.
Abdul Masood Farooqi, Karachi, West Pakistan
Stanley Dale Foreman, Lubbock, Texas
Sotirios Gregory Grigoropoulos, Rolla, Mo.

Elijah Henry Girven, New York, N. Y.
David Brewster Hammond, Marysville, Calif.
Helmer Francis Hanson, Los Angeles, Calif.
Richard Alfred Hosegood, Pasadena, Calif.
William Harold Huffman, San Francisco, Calif.
David Paul Hull, Detroit, Mich.
Herbert Tadashi Iwai, Oahu, Hawaii
Stephen Edward Kicinski, Jr., Houghton, Mich.
Kenneth Lester Lee, Berkeley, Calif.
William Joseph Levine, New York, N. Y.
Severo Alejandro Lopez, Kansas City, Mo.
Manuel Lopez-Herrera, Caracas, Venezuela
Howard Hans Mattson, New York, N. Y.
Greg Charles Meyer, Durango, Colo.
Richard Bruce Morrison, Camden, N. J.
Lawrence Ogden Oliver, Los Angeles, Calif.
Dexter Jorgen Olsen, Northbrook, Ill.
Wayne Frederick Peters, Cleveland, Ohio
Alfonso Pujol, Mendoza, Argentina
Jijjarapu Raja Rao, Andhra Pradesh, India
Steve Masayoshi Saiki, Decatur, Ill.
Reynaldo Thomas Salas, Jr., Austin, Texas
Avinash Chandra Singhal, London, England
Huseyin Sinasi Suphi, Nicosia, Cyprus
Kalphaty Vydinathan Swaminathan, Bangalore, India
George Elias Tarakji, Syria
Snadra Jean Truitt, Kansas City, Mo.
Mahadeva Swaminatha Venkatesan, Berkeley, Calif.
David Walter Waldby, Brisbane, Australia

[*Applications for the grade of Associate Membership from ASCE Student Chapter Members are not listed.*]

Non-ASCE Meetings

American Concrete Institute. Fifty-eighth annual convention at the Brown Palace Hotel, Denver, Colo., March 12-15, 1962.

Associated Equipment Distributors. Forty-third annual meeting at the Hilton Hotel, Chicago, Ill., January 28-February 1, 1962.

Associated General Contractors of America. Forty-third annual convention in Los Angeles, Calif., February 26-March 1, 1962.

National Academy of Sciences-National Research Council. Annual meeting of the Highway Research Board at the Sheraton-Park Hotel, Washington, D.C., January 8-12, 1962.

National Bituminous Concrete Association. Seventh annual convention at the Flamingo Hotel, Las Vegas, Nev., February 17-22, 1962.

National Limestone Institute. Meeting at the Roney Plaza Hotel, Miami Beach, Fla., January 15-19, 1962.

National Sand and Gravel Association-National Ready Mixed Concrete Association. Thirty-second annual convention and biennial show at the Conrad Hilton Hotel, Chicago, Ill., February 5-9, 1962.

National Society of Professional Engineers. Winter meeting at the King Edward Hotel, Jackson, Miss., January 25-27, 1962.

Northwest Roads and Streets Conference (formerly Northwest Highway Engineering Conference). Annual meeting on the campus of Oregon State University, Corvallis, Ore., February 2-9, 1962.

RECENT BOOKS

(added to the Engineering Societies Library)

Coefficients for Analysis of Two and Three-Span Continuous Beams of Constant Moment of Inertia

This volume, with tables covering up to 215 span ratios, provides a quick direct reference for those concerned with the structural design or investigation of continuous beams. The tables include load conditions which seem to cover most of the practical problems met in structural engineering. They enable either an exact or an approximate analysis of such problems as the dead load analysis of bridge stringers, the comparison and design of floor systems and building beam analysis and design. Used directly, without recourse to influence lines, they provide a quick, complete analysis of beams subjected to complicated loading conditions if the principle of superposition is applied properly. (Prepared and published by the Stanley Engineering Company, Muscatine, Iowa, 1961. 229 pp., bound. $12.50.)

Library Services

Engineering Societies Library books, except bibliographies, handbooks, and other reference publications, may be borrowed by mail by ASCE members for a small handling charge. The library also prepares bibliographies, maintains search and translation services, and can supply a photoprint or a microfilm copy of any items in its collection. Address inquiries to R. H. Phelps, Director, Engineering Societies Library, United Nations Plaza, 345 East 47th Street, New York 17, N. Y.

Specifications
Second Edition

This is an introductory text in the writing of architects' specifications. The good and bad points in the selection of words and phrases, the logic behind the grouping and arrangement of sentences, paragraphs and sections, and the methods involved in the assembling of the facts and their organization, are presented herein, along with enough technical information to illustrate the entire procedure of specification writing. Part 1 deals with the general aspects of specification writing, which have changed relatively little since the first edition in 1953. Part 2 deals with the general conditions during construction and specific trades involved in construction, as related to specifications writing for non-fireproof types of construction, and revisions are more extensive, to embrace materials and methods developed since 1953. (By H. Griffith Edwards. D. Van Nostrand Company, Inc., 120 Alexander Street, Princeton, N. J., 1961. 372 pp., bound. $6.00.)

Statically Indeterminate Structural Analysis

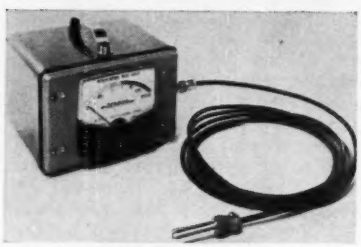
In his treatment of indeterminate structural analysis, the author approaches the subject from the standpoint of method rather than by problem type. In addition he stresses a few methods which are most widely applicable, and discusses them at length, progressing from simple to complex problems. Throughout the text, emphasis is placed upon deflections, structural visualization, and the interrelationships between the various methods. Moment area, virtual work, moment distribution, and other methods are described. (By R. L. Sanks. The Ronald Press Company, 15 East 26th Street, New York 10, N. Y., 1961. 602 pp., bound. $10.00.)

EQUIPMENT, MATERIALS and METHODS

NEW DEVELOPMENTS OF INTEREST AS REPORTED BY MANUFACTURERS

Radiation Instrument

THE SENSOR is a device which provides radiation level information of the immediate shelter vicinity without the necessity of going outside and being exposed to possible high levels of radiation. It employs the basic, proven features of radiation measuring devices used for years. The detector is mounted outside on a post, or on the side of a building. It is contained in a waterproof housing and is



Radiation Detector

rugged enough to withstand all ordinary hazards. The indicator is pushbutton operated to conserve battery life. The instrument dial is direct reading, with dangerous radiation levels shown in red. A cable leads from the detector into the shelter and connects to the indicating unit. **Radiation Equipment and Accessories Corp., CE-12, 665 Merrick Road, Lynbrook, New York.**

Basement Fallout Shelter

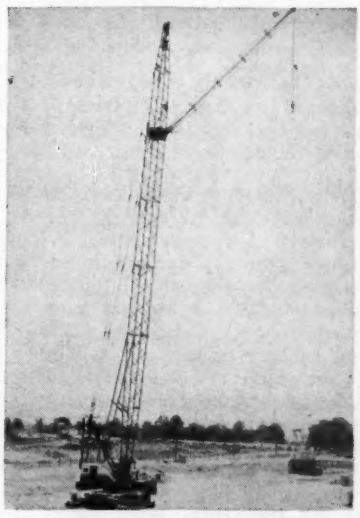
A BRICK BASEMENT FALLOUT SHELTER which can protect a family against radioactive fallout for two weeks meets government civil defense standards for effective shelter. It is one of five such brick and tile designs to shield a family against fallout during the two weeks it may be necessary to remain under cover. The brick shelter with its 8 in. thick walls can be built into the basement of an existing home or easily incorporated into a new residence. Brick, which is made of hard-burned clay, has a natural density highly suitable to fallout shelter construction. Structural clay tile, 8 in. thick and filled with sand also offers radiation protection. Using the Office of Civil and Defense Mobilization recommendation of a minimum of 10 sq ft of floor area and 65 cu ft of volume per person, the basic brick shelter will provide a family of six with a usable floor area 10 x 6 ft 8 in. and a ceiling 6 ft 2 in. high. One feature of the shelter is an entrance with a right-angle turn which reduces radiation intensity inside. Ventilation is provided by vents in the wall and by the open entrance. **Structural Clay Products Institute, CE-12, 1520 18th Street, N.W., Washington 6, D. C.**

Grade Indicator

THE GRADE-O-METER, a grade indicator, is quickly mounted on any motor grader, bulldozer, scraper, or other equipment. A quick glance at the 9-in. dial tells the exact slope or grade being cut. Deviations from the horizontal are magnified eight times by the dial indicator. The dial is scaled to give four simultaneous readings: the actual slope expressed in percentage, the slope expressed as a ratio and the crown slope on each half of a 24-ft or 32-ft roadway. Despite its sensitivity, the Grade-O-Meter is said to be a rugged, durable instrument. There are no electronic or other delicate elements which can get out of adjustment. **Fredon Company, CE-12, Spearfish, South Dakota.**

Dual Purpose Truck Crane

THE VERSATILITY OF A TRUCK CRANE and the advantages of a tower crane have been combined into a single basic machine called "Marion Mobiltower". It is basically a 30-ton, Type 37-M truck crane. Mounted on an 8 x 4 carrier with hydraulic outriggers, it can handle loads of from 10,000 lb at a 20 ft radius to 5,000 lb at a 60 ft radius at heights of 107 to 150 ft. The tubular T-1 steel boom with tubular lacing does double duty as both the tower and as a conventional boom. The standard type jib also doubles as either the tower jib or as a conventional jib connected to the boom point. The

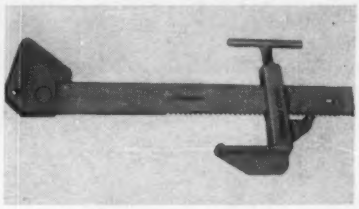


Truck and Tower Crane

equipment required to convert the 37-M from standard crane to "Mobiltower" crane includes: 2.5 ft insert with jib connection for main boom; hoist line fairlead; jib bridle; boom point deflecting sheaves; boom stop extensions and stabilizer; and wheel-mounted outriggers. **Marion Power Shovel Co., CE-12, Marion, Ohio.**

Adjustable Aliner Clamp

AN ADJUSTABLE ALINER CLAMP, which simplifies the setting of steel forms used in the construction of concrete pilasters and curved walls, is being marketed under the name EFCO Adjustable Aliner Clamp. When used in the forming of pilasters, this clamp usually eliminates the need for spreader ties through the pilasters. This results in considerable savings in spreader tie costs, makes special



Adjustable Clamp

length spreader ties unnecessary, and improves the appearance of the pilaster. A second use for the clamp is in the alinement of form panels for curved walls with ordinary 2 x 4's or 2 x 6's. This reduces bracing, allows movement of forms in large panel assemblies, and eliminates the need of cutting special wood aliners to fit the curve of the wall. **Economy Forms Corp., CE-12, Box 128-G, Highland Park Station, Des Moines, Iowa.**

Surveying Instruments

THE SITE-MARKER, a line of surveying instruments, features two levels and two transit levels. The models include the No. 5158 Level and the No. 5159 Transit-Level. Both are made of die cast aluminum and feature 6-in., 10x telescopes with micrometer focusing, and a wide field of view with 3.5 ft minimum focus. Completing the series are the No. 5162 Level and the No. 5163 Transit-Level. These instruments have 10-in., 18x telescopes with internal focusing adjusted by large knobs on either side of the tube. Construction is of aluminum alloy with all enclosed standard and base; nickel-plated brass adjustment screws; and a 1⅞ in. leveling vial with 10 min per 2mm sensitivity. Adjustments are positive locking, and a smooth green hammertone finish provides easy cleaning. **Keuffel and Esser Co., CE-12, Third and Adams Streets, Hoboken, N. J.**

EQUIPMENT MATERIALS and METHODS

(continued)

Soil Pressure Measurement

A GROUP OF HOMES built recently in the St. Louis, Mo., area became completely unsafe and uninhabitable because of the soil on which they were built. The soil—called loess—is a silty type soil which causes no difficulty in its natural, undisturbed state. However, it reacts violently when subjected to man-made water conditions such as roof runoff of rain, lawn sprinkling, septic drainage, landscaping, etc. This excessive water causes the loess soil to swell uncontrollably and exert enormous natural pressures—pressures which cause break-up of foundations and, ultimately, destruction of the building. The Federal Housing Administration has developed a device for pressure measurement. This equipment, called the P. V. C. meter, is used to evaluate soils for swelling characteristics. FHA recommends the use of this instrument as a testing device for the soils on which any residential and commercial buildings will be placed. **Soiltest, Inc., CE-12, 4711 W. North Avenue, Chicago, Ill.**

Masonry Fastening Tool

PIN BOY, a hammer-drive masonry fastening tool, directs a hammer's striking energy straight down, focusing the force to drive the fastening pin into steel, concrete and similarly tough materials. No drilling or bolting is required in making fastenings with the tool. A special feature is a reversible barrel permitting the use of a masonry drill, with the change from pin-driving position to drilling position, and vice versa, being made in a few seconds. The new pins are made of specially alloyed and hardened steel for maximum strength and holding power, and are available in a variety of sizes and styles, including those used in wire-loop pinning applications. **Remington Arms Company, Inc., CE-12, Bridgeport, Connecticut.**

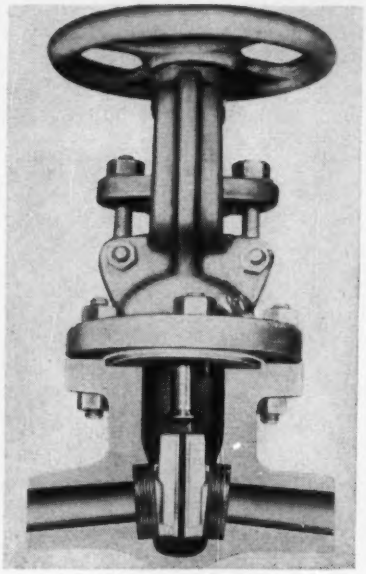
Pocket Altimeter-Barometer

THE EVEREST POCKET ALTIMETER-BAROMETER will not answer the question, "How high is up?". It will, however, tell its user how high he is up. The instrument works on the barometric principle; that is through the measurement of air pressure. A small aneroid capsule, which is sensitive to the slightest fluctuation in air pressure, is contained in the package. As the capsule expands or contracts, depending on pressure, its movements are transmitted to the pointer by a very precise and shock-resistant mechanism. The altimeter is easily read with the help of a pointer and recording disk. It records altitudes up to 18,000 ft above sea level. **AGA Corporation of America, CE-12, P. O. Box 447, South Plainfield, New Jersey.**

(continued)

Bi-Valve

THE "BI-VALVE", featuring self-conforming, positive seating and absolute shut-off, is designed around a swivel principle which permits the discs to individually conform to seat faces even with severe pipe strain or distortion due to temperature swings. Made of steel, they come in a wide variety of sizes starting at 2 in. and are available in all pressure classes. The valves have the inherent flow efficiency of gate valves and absolute shut-off ability, thought to be exclusive in globe valves. Thus, where globe valves have been preferred in certain applications, it is now possible to use smaller pipes, valves and fittings in many areas in chemical, petroleum, power and marine applications. Maintenance time and costs are reduced since standby valves generally are unnecessary, the discs can be changed without removing the valve from the line, the discs are interchangeable with solid wedges and can be reversed for wear compensation; there is no sticking when closed hot and opened cold; galling or seizing on seating surfaces is negligible and the self-conforming discs require less spindle thrust for perfect sealing. **The Chapman Valve Mfg. Co., CE-12, 203 Hampshire Street, Indian Orchard, Mass.**



Two-Fold Valve

Water-Proofing Agent

THIS AGENT, called Surtiseal, is a clear colorless liquid containing esters of boron and silicon in an aqueous base. Applied to masonry, it is readily absorbed into the surface and protects the surface against subsequent absorption of water and destruction by freezing and thawing for periods of 5 to 10 years. It can be applied to wet cement or concrete and to damp basement walls, with the same effectiveness as on dry masonry. A thorough application of it to concrete walls can protect them against the presence of substantial water pressure, which results in permeation and oozing of water to produce wetness or dampness. Surfaces treated with this agent show no adverse change in appearance. **Guardian Chemical Corporation, CE-12, 38-15 13th Street, Long Island City 1, New York.**

Electronically Controlled Concrete Plant

FOXON CONCRETE CORP., New Haven, Conn., unveiled the first remotely operated ready-mix plant in New England producing rigid specification concrete automatically and electronically from preset formulas. The installation consists of a high capacity, automatic batching plant that weighs all materials simultaneously

(Continued on page 116)

(continued)

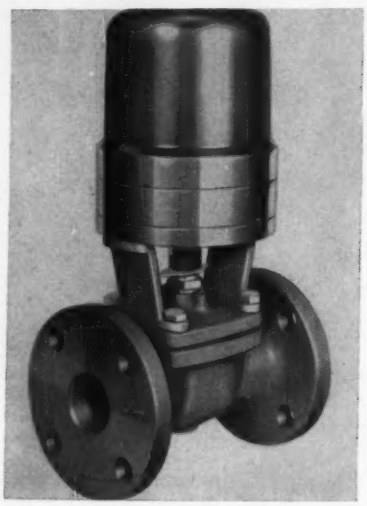
and a central control station housing a remote, electronic batching console and graphic recorder. The push-button controlled console operates the batching and dumping cycles completely automatically. The operator selects one of ten mix designs pre-set on the console. From the first batch to the last, the proportioning of materials for all batches of a given design are identical. Controls are fully interlocked to meet specifications. The console electronically adjusts quantity of sand and water to compensate for variation in percent of moisture to insure proper slump control. **Noble Company, CE-12, 1860 7th Street, Oakland, California.**

Heat Resistant Ink

A heat-resisting ink, designed specifically for use as identification marks on steel, copper, brass and on welding rods, able to withstand temperatures up to 2500 deg F, is called "Okie Heat-Resisting Yellow". Applications in the steel industry include: 1. Identification marking on welding rods in order to insure the proper weld for a specific type of steel. The ink can be used for printing the full length of the rods and/or marking the end, which has been the standard procedure up to the present time. 2. Identification marking for heat treated steel, copper and brass which will designate specification number or any other data required and will not rub off under high temperatures. **F. G. Okie, Inc., CE-12, Ambler, Penn.**

Electrically Operated Ball Valves

ELECTRIC OPERATORS with top-entry ball valves for automatic and remote on-off flow control applications are sold integrally with the valves or separately for bolting directly to the bonnet of any valve already in service. Features of the



Top-Entry Ball Valve

operators include: weatherproof and explosion-proof construction, stainless steel output shaft, aluminum housing, and hardened steel gear train. Cycle time to fully open or close the valves is from 5 to 12 sec, depending on valve size. The electrically operated valves are available in 1 to 8 in. sizes for pressures to 720 psig and temperatures to 1000 deg F. Ductile iron, carbon steel, stainless, bronze, and aluminum bodies with screwed, socket end, or flanged ends are standard. The valves feature wedge-seat construction which provides automatic wear take-up and assures leaktight closure for the life of the seat material. Top-entry design enables the valves to be serviced without removing them from the line. **Hills-McCanna Co., CE-12, 400 Maple Avenue, Carpentersville, Ill.**

Literature Available

AQUALINE PUMPS—An expanded line of split-case horizontal building trade pumps are produced with either a mechanical shaft seal or chevron packings. The pumps are available in both types in a size range of 1.5 to 8 in. discharge. Capacity of the packed type pumps is 2,600 gpm with 280 ft head range. Temperature range is 250 deg F. In the sealed type, the capacity is 750 gpm (at 3500 rpm) and 2600 gpm (at 1750 rpm). Head range is 350 ft (at 3500 rpm) and 280 ft (at 1750 rpm). Temperature limit is the sealed type Aqua-Line is 225 deg F. **Peerless Pump, Hyd. Div., FMC Corp., CE-12, 301 West Avenue 26, Los Angeles 31, California.**

HIGH TEMPERATURE WIRES, CABLES, TUBINGS—This 58-page catalog has 29 sections containing synopses of government wire specifications, government and commercial specifications, new product highlights, easy-reference tabulations on applicable military specifications, U. L. listings and ratings, physical dimensions and dielectric strength and temperature ratings for the company's magnet wire. **Hitemp Wires Co., A Div. of Simplex Wire & Cable Co., CE-12, 1200 Shames Drive, Westbury, L. I., New York.**

ENGINEERING DATA BULLETIN—This 16-page bulletin deals with the problems of waste treatment, classification of wastes and the methods of solving these problems. Four general classes of waste for food, mineral products, chemical processing and general industry, with their characteristics and strengths, are discussed. Equipment and processes used in unit treatment are detailed. **B-I-F Industries, CE-12, Providence 1, Rhode Island.**

ELECTRIC CRANES—A 12-page bulletin, No. 540, containing photographs, illustrations and technical information about the complete line of full revolving, all electric cranes, has just been released. The bulletin describes over nine different crane models that range in capacities from 150 ft tons to 16,250 ft tons. In addition, it points out many of the advantages to be gained through their application. **R. G. LeTourneau, Inc., CE-12, 2399 South MacArthur, Longview, Texas.**

ROTOFLO VALVE—In the Ludeman Rotoflo Valve the ball is rotated by an eccentric cam which lifts the ball away from the seat before it is turned to open, thus eliminating sliding friction and permitting the use of hard metal seating surfaces. The valve is fast acting, has a full-round flow passage and provides positive shut-off. The brochure, PB911, lists complete operating and application features with specifications and line drawings. **General Kinetics Corp., CE-12, 197 South Van Brunt Street, Englewood, New Jersey.**

Literature Available

FALL-OUT SHELTER ENGINE GENERATORS—provide independent electric power for lighting, ventilation, radio, hot plate, and even a refrigerator. Maximum efficiency and minimum operating cost are made possible by the use of 12 volts DC for lighting and ventilation—115 volts AC for radio, hot plate, and refrigeration. These units are powered by liquified petroleum fuel for dependability and maximum safety. **Wincharger Corp., CE-12, Sioux City 2, Iowa.**

APPLICATION CHART FOR SPECIALIZED LUBRICANTS—An application chart is being offered to industry for the purpose of simplifying proper selection of lubricants containing the ingredient molybdenum disulphide. The chart lists forms of applications as dry powders, aerosol spray, greases, liquids, and bonded coatings. It defines types of Super-Moly by large particle and small particle, classifying lubricants by number and itemizing the package, the base or "carrier" for the lubricant, typical uses and methods of application. **J. A. Postell, CE-12, 936 West Peachtree Street, N.W., Atlanta 9, Ga.**

A NATIONAL HANDBOOK OF NEW AND USED CONSTRUCTION EQUIPMENT VALUES—Contained in a 12-ring binder, separated into 18 tabbed sections, the Green Guide Handbook for 1962 will contain more comprehensive model coverage in both heavy and light equipment, with more complete and up-to-date serial numbers, with figures revised to reflect current values. Monthly bulletins and individual appraisal reports on equipment not listed are to be an integral part of the Guide service. **Green Guide Company, CE-12, 615 University Avenue, Palo Alto, California.**

ELECTRIC PLANTS FOR FALLOUT SHELTERS—This 4-page folder describes various models and sizes of generator sets suitable for fallout shelter installation and how and where to install them. Included, too, are four tables—giving the fuel consumption of models from 2 to 5 kw; how much wattage essential shelter appliances require; how much cooling air each size plant needs; and the dimensions, weight, and wattage of each. **Kohler Company, CE-12, Kohler, Wisconsin.**

LIQUID CHEMICAL CEMENT INTENSIFIER—Insuro is a liquid chemical compound, the ingredients of which, in chemical combination with Portland cement, accelerates and more completely hydrates the cement particles; producing a stronger and more dense concrete. This bulletin gives complete specifications and data covering all applications. **Insuro Chemical Co., Inc., CE-12, Box 208, Worcester 1, Mass.**

From the MANUFACTURERS

SUBSIDIARY: Ingersoll-Rand Company has formed a wholly-owned subsidiary, Ingersoll-Rand de Puerto Rico, Inc., with headquarters at San Juan . . . Ets-Hokin & Galvan, Inc. has announced the formation of a subsidiary organization, the Technical Construction Company (TECON) . . . **AGREEMENT:** Little Giant Products, Inc., Illinois, and Oldham & Son, Ltd., of England have concluded an agreement whereby Little Giant Lift Truck Attachments will be manufactured and sold by Oldham in Western Europe and throughout the British Commonwealth of Nations . . . **CONSTRUCTION:** The Fluor Corporation, Ltd. is constructing a Udex unit for Standard Oil Company of California at its refinery near Richmond, California . . . **NEW DIVISION:** The formation of a Government Projects Division has been announced by Dorr-Oliver Incorporated, Stamford, Connecticut . . . **DISTRIBUTOR:** CRS Industries, Inc., announced the appointment of the Paller Engineering Company as the exclusive distributor of the Statronic System in Northern Indiana . . . The Lupear Products, Inc., announces a change in their service, distributorship and dealership set-up. It will be handled exclusively from the main offices located at Walled Lake, Michigan . . . Carroll & Edwards Company, Ohio, has been appointed a distributor for southeastern Ohio and three bordering counties in Kentucky by Kwik-Mix Company, Wisconsin . . . Howard T. Moriarty Co., Toledo, Ohio, has been appointed exclusive distributor for Ka-Mo products in northwestern Ohio . . . Crenshaw Equipment, Inc., Orlando, Florida, has been appointed a distributor for the entire state of Florida, by the C. S. Johnson Co., Champaign, Illinois . . . **ACQUISITION:** Vapor Corporation has acquired the business and assets of the Transit Division of National Pneumatic Co., Inc., Boston . . . **NEW LOCATION:** Pioneer Industries has recently moved their plant and offices to Carlstadt, New Jersey . . . **NEW NAME:** American-Marietta Company has changed its name to the Martin Marietta Corporation after their merger with the Martin Company . . . **APPOINTMENTS:** Edward E. Brush was elected a director of Soiltest, Inc. at the firm's recent board of director's meeting . . . L * A Water Conditioning, Inc. has appointed two leading industrial marketing organizations as sales representatives. Flagg, Brackett & Durgin, Inc. will cover most of the New England States and Bradbury, Kendrick Associates, Inc. will cover the greater Detroit area . . . Donald W. Hunt has joined the staff of Engineers Incorporated as Assistant to the Vice President . . . Furlow-Laughlin Equipment, Inc. has been appointed southern Louisiana distributor for Koehring, Parsons, C. S. Johnson, Buffalo-Springfield, and Ka-Mo construction equipment . . . A. B. Fisher, Jr. has been appointed Chief Engineer of the Engineering and Construction Division of Koppers Company, Inc. . . . Dick Fowler has been appointed special factory representative by the Viber Company . . . H. D. Weller has been appointed to the newly created position of Vice President, Director of Marketing of the White Motor Company . . . Dr. Frederick D. Ezekiel has been named General Manager of American Measurement and Control, Inc., a subsidiary of CompuDyne Corporation . . . James R. Gronseth has been appointed as Manager of the Hoist Department, Mining Division of the Nordberg Mfg. Co. . . . Hodgson Equipment Company, has been appointed sales representative for Cleveland Tramrail overhead materials handling equipment . . . The Rainey Co., sales agency for General Blower Company, announced the appointment of Neal B. Heaps as sales engineer . . . Al Kaufmann has been appointed sales representative for Ilg Electric Ventilating Company . . . Theodore W. Van Zelst was elected a director of the Cenco Instruments Corporation . . . Dr. John Anthony Hrones has been elected a director of CompuDyne Corporation . . . L. A. DePolis, former Vice President, Marketing of LeTourneau-Westinghouse, was named President and a Director of FWD Corporation by the FWD Board of Directors.

ENGINEERING SOCIETIES PERSONNEL SERVICES, INC.

(AGENCY)

New York	Chicago	San Francisco
8 W. 40th St.	29 E. Madison St.	57 Post St.

These items are listings of the Engineering Societies Personnel Service, Inc. This Service, which cooperates with the national societies of Civil, Chemical, Electrical, Mechanical and Mining, Metallurgical and Petroleum Engineers, is available to all engineers, members or non-members, and is run on a nonprofit basis.

If you are interested in any of the listings, and are not registered, you may apply by letter or resume and mail to the office nearest your place of residence, with the understanding that should you secure a position as a result of these listings you will pay the regular placement fee. Upon receipt of your application a copy of our placement fee agreement, which you agree to sign and return immediately, will be mailed to you by our office. In sending applications be sure to list the key and job number.

When making application for a position include eight cents in stamps for forwarding application.

Men Available

CHIEF OR SENIOR STRUCTURAL ENGINEER, M. ASCE, B.C.E., with 12 years' valuable experience in both highway bridges and industrial buildings, desires permanent position with established firm in Manhattan or Westchester County. Salary, $12,000. C-722.

HEAVY CONSTRUCTION ENGINEER, A.M. ASCE, B.C.E. One and a half years of experience in bridge construction including field layout, foundation, structural steel, concrete work, and quantities and related field work, desires similar work with construction company. Salary, $6,600. C-723.

MUNICIPAL AND PUBLIC HEALTH ENGINEER, M. ASCE, M.S.E. (Civil), 33. After 4 years of responsible work in municipal engineering and four years of responsible work in public health engineering is well acquainted with engineering problems in local and metropolitan areas. C-725.

CIVIL ENGINEER, M. ASCE, Diploma—Zurich, Switzerland, Canadian, 34. Nine years' experience, planning and designing sewage treatment plants, construction expansion of textile mills, construction expansion of hydro electric power plants and cost estimates. Speaks English, German and French. Now in Switzerland. Prefer Europe or Overseas. C-726.

SOILS AND FOUNDATION (MATERIALS) ENGINEER, M. ASCE, M.S. Soil Mechanics and Foundation Engineering, M.S. Highway Engineering. Registered P.E. About 9 years' domestic and foreign experience in all phases of soils, foundations and materials, including field and laboratory work. Diversified background includes design and construction of highways, buildings, dams, etc; special facility in report and specification writing. Prefers work with consulting engineers. Available immediately. C-728.

ENGINEER, J.M. ASCE, B.C.E., M.C.E., P.E. Six years' experience in planning, supervising and designing buildings, bridges and special structures, plus two years construction. Seek administrative position. Salary, $10,000 minimum. New York area or Foreign. C-729.

GROUND WATER ENGINEER, F. ASCE with 25 years of experience in geological investigation, test drilling, production installations, and hydrology. Experience also includes industrial contracting and engineering operations and management, such as 3 years as resident engineer on overseas installation program. Interested in aspects of investigation, installation, or operation either in the U.S. or abroad. C-730.

PROJECT MANAGER, PROJECT ENGINEER, F. ASCE, S.B., S.M. (Business and Engineering Administration and Civil). In design, administration, management and field engineering for 26 years. Extensive recent experience in roads, airfields, water and sewerage systems, and military installations for support for missile and communication systems. Salary, $14,500. C-731.

OWNER'S REPRESENTATIVE OR PROJECT ENGINEER, A.M. ASCE, M.S.C.E. Registered P.E. in Pennsylvania, Ohio and Kentucky, 36. Responsible for scheduling and supervising the drafting and structural design of commercial and industrial structures for various consulting engineers in Pennsylvania and Ohio. C-2309-Chicago.

SALES ENGINEER, M. ASCE, B.S.C.E., 38. Broad, responsible experience estimating and supervising, both private and public works, industrial buildings, bridges, flood control, etc.; chiefly for contractors. Midwest, West, Foreign. C-2310-Chicago.

CHIEF ENGINEER, A.M. ASCE, B.S.C.E., 46. Twenty-three years' construction office and field experience in heavy steel construction as buildings, bridges, ore docks, conveyors, power houses, steel mills and petro-chemical plants. Salary, $12,000. C-2311-Chicago.

PROJECT, CONSTRUCTION OR PLANT ENGINEER, M. ASCE, M.S.C.E., 34. Ten years' construction and maintenance experience on process plant and refinery work, gas and oil piping, marine pipelines and foundations, tankage and structural design work. Good record with costs, scheduling, labor. Salary, $12,000. U.S., Europe, Australia. C-2312-Chicago.

STRUCTURAL ENGINEER, M. ASCE, B.S.C.E., 44, with experience in design, layout, detailing of plant and mine facilities for mining and beneficiation of iron ore. Also conveyor design, pumps, residential sub-division, heavy media plant, and roasting plant for semi-taconites. Changes in experimental taconite plant. Salary, $12,000. Midwest and West. C-2313-Chicago.

ASSISTANT SUPERINTENDENT OR SUPERINTENDENT, M. ASCE, B.S.C.E., 37. Supervisory and field engineering experience in construction of industrial, hospital, and commercial buildings. Includes high rise apartment and office buildings. Salary, $750 per month. Chicago area. C-2314-Chicago.

BRIDGE DESIGNER OR STRUCTURAL RESEARCH ENGINEER, M. ASCE, B.C.E., M.Sc., 34. With consulting engineers as bridge designer of continuous steel beam, welded girder and arch bridges for 4½ years. Additional 2 years of general civil engineering and 9 months of supervisory experience. Midwest or East. C-2315-Chicago.

SUPERINTENDENT HEAVY BUILDING CONSTRUCTION, M. ASCE, CE, 39. Fourteen years on commercial and industrial building and heavy construction with responsible charge of every phase of construction from take-off, pre-bid planning, estimating, bidding, job planning, engineering to administration of jobs from 40,000 to 4,000,000. Projects successfully completed include pipelines, bridges, piers, wharfs, trestles, caissons, dams, penstocks and various reinforced concrete and frame buildings. Salary, $18,000. Northern California. Se-1753.

This is only a sampling of the jobs available through the ESPS. A weekly bulletin of engineering positions open is available at a subscription rate of $4.50 per quarter or $14 per annum, payable in advance.

ESTIMATOR, M. ASCE, CE, 40. Proven business and promotion ability, including 15 years of experience from selling kitchen cabinets to heavy construction. Presently estimator and construction superintendent. Salary, $12,000. Oregon or North California. Se-1080.

PROJECT OR RESIDENT ENGINEER, A. M. ASCE, CE, 41. Eighteen years of U.S. and Foreign experience in the design and construction of housing and camp developments, industrial buildings and installations, all utilities, streets, harbor facilities, also architectural design and planning. Salary, $10,000. Foreign or Southwest U.S. Se-1802.

PROJECT OR FIELD ENGINEER, M. ASCE, CE, 39. In 12 years rose from draftsman to chief civil engineer. Well versed in quantity and progresss reports, costs, administration and management demands of construction. Know design in hydraulics, wood steel, concrete, field layout and surveying, handling reports and correspondence. Salary, $10,800. West Coast, Southwest. Se-1373.

DESIGNER, M. ASCE, 32. Seven years on highway location, design, construction, soils and administration, plus two years on conduit line construction. Salary, $8,400. West Coast. Se-1517.

DESIGNER, M. ASCE, CE, 39. Fourteen years of varied design experience in progressively responsible positions including civil, structural, hydraulic, hydroelectric, mechanical (bulk materials handling) design and related duties for consultants and major designers and constructor of industrial plants. Salary, $9,600. West. Se-1777.

SUPERINTENDENT, A.M. ASCE, CE, 29. Four years supervision, scheduling, layout, codes, specifications, general construction, utilities, roads. Salary, $7,500. South America or Foreign. Se-1759.

HYDRAULIC CONSULTING ENGINEER, A.M. ASCE, CE, 30. For three years engaged in highway and sub-division work in both field and office; designed hydraulic structures for highway and subdivision projects; with U.S. Geological Survey Surface Water Branch (1½ years); and recently for 4 months designed and analyzed pre-stressed concrete highway grade separation structures. Salary, $7,800. San Francisco, Western U.S. Se-1706.

CIVIL ENGINEER, A.M. ASCE, CE, 26. Two years designing, drafting structures, such as power plants, paper plants, office buildings, and residence. Salary, $7,200. Prefer California. Se-1849.

DESIGN CONSULTANT, M. ASCE, CE, 26. Recent graduate with over a year inspections and appraisals of water and sewage treatment plants, existing and proposed. Some design and field work in sub-division watermains, sewers and roads. Summer experience in all phases of legal surveys. Salary $7,200. San Francisco. Se-1844.

STRUCTURAL DESIGNER, A.M. ASCE, CE, 33. Two years structural design, five years architectural, and one year teaching. Salary, $4.20 per hour. San Francisco. Se-1718.

CITY, COUNTY PUBLIC WORKS ENGINEER, A.M. ASCE, CE, 28. Six years' experience on the design and construction of highways structures, hydraulic projects, economic studies of alternative projects, and report writing. Salary, $7,200. Midwest or East. Se-1652.

Positions Available

SENIOR CITY ENGINEER, degree in civil engineering, with minimum of 4 years' experience required. Must have or be eligible for a New York State Professional Engineer's license. $6,708-$8,268. Upstate New York. W-1012.

RESIDENT ENGINEER, graduate civil, with at least 10 years' supervisory engineering and reinforced concrete multi-story building construction experience including piling foundations. Must be U.S. citizen and familiar with payments on unit cost contract work. $15,000 plus housing. Middle East. F-979(a).

SUPERINTENDENT OF CONSTRUCTION, with high-rise building experience, particularly apartment construction. $13,000. N.Y.C. W-974.

CIVIL ENGINEER for work on hangars and pavements. Must have had at least 3 to 4 years' experience with reputable construction firm. Single status. $10,800 plus transportation. Ethiopia. F-973.

METHODS AND MECHANICAL ENGINEER, graduate mechanical or industrial, or civil with some methods experience, and some background in the construction industry, specifically at construction sites. Experienced in the metals trades, preferably in forming of sheet metal fabrications of pipe, etc. Will research, develop and recommend improved methods for the shop fabrication and the field installation of heating, air conditioning and plumbing systems and assist in installation. $10,000-$12,000. Western Pennsylvania. W-964.

CIVIL ENGINEER, preferably with some experience in port installations. About $10,000. North Atlantic area. W-963.

PROJECT ENGINEER, CE, 30-35, with 10 years of general construction experience to supervise, check design of company owned buildings on the west coast. Car furnished for travel 40 to 50 per cent of time in western states. $700-$800 per month. Sj-6643.

ASSOCIATE, CE, Reg P.E. Calif. General practice civil engineer seeks partner and ultimate successor. Work includes municipal (streets, sewers, sewage treatment, water), sub-divisions, land and construction surveying and structures. Monterey County (Calif.) Sj-6653.

MARKETING ENGINEER, any age. Should have 2 years' background in sales, working with architects and builders. Knowledge of aluminum, application, metal curtain wall. For Los Angeles manufacturer. Salary open. Sj-6622.

SUPERINTENDENT (PUBLIC WORKS) CE, with 2 years as professional civil engineer. Will plan, direct design and preparation of drawings, specifications and estimates on buildings, bridges, roads, utility lines, dams, hydraulic facilities; in-

spect structures, analyzes structures, highways for a government department in Sonoma County. $647. Sj-6608.

BUILDER AND SALES AIDE, subdivider background, any age. Seasoned man to build and sell houses of $30,000 and up for a contractor-developer. Able to handle clients, demonstrate properties, bills of material, lumber lists, house design and construction. $600 plus per month. Central Calif. Sj-6482.

SALES TRAINEE, CE background, any age. Recent graduate or year general contractor background. To learn small general contractor business from office, negotiations, will represent firm to owners. Car required for limited travel in San Francisco Bay Area. $600 per month. Sj-6642.

DESIGNER, CE, Calif. Reg., to 64, with 4 years as professional civil engineer, 2 of them supervising design construction of highways, bridges, advanced road programming. For county department. $909-$1,002 per month. Southern California. Sj-6626.

STRUCTURAL DESIGNER; Engineer-builder requires CE preferably with advanced study. Should be completely qualified in minimum weight rigid frame steel, concrete; stress analysis, deflection and vibration; development and experimental steel, concrete pedestal-floors-substructures; plus waldments and castings, for moving, large saucer type radio antenna. Employer pays fee. $800-$1,200 per month. San Francisco Peninsula. Se-6599.

DESIGNER, DRAFTSMAN, CE, 25-35, with 2 to 3 years' experience in consulting office; structural design, drafting on small wood and steel frame buildings. For consultant. Salary open. San Francisco East Bay. Sj-6605.

CHIEF-CONSTRUCTION ENGINEER, CE, to 45. Contractor stipulates background in tunnel and dam construction, and familiarity with Corps of Engineers and Bureau of Reclamation work. Must also be able to handle estimating and change order negotiations. Utah. Sj-6655.

HYDRAULIC DESIGNER, CE, to 45, to work for consultant. Fifteen years' experience designing irrigation and drainage systems, major irrigation structures. Prepare preliminary design, review designs, prepare reports. Salary open. Pakistan. Sj-6617.

STRUCTURAL DESIGNER, CE, Calif. Reg. to 40. Five years structural design, detail prestressed and reinforced concrete, steel, timber, masonry buildings, sub divisions, improvements, new construction and repairs. For consultant. $800 per month. San Francisco Peninsula. Sj-6633.

OFFICE ENGINEER, U.S. citizenship required, young. Five to 10 years of field and office experience, such as construction and estimating on heavy construction (dams, tunnels, power houses, missile sites). $160 per week. San Francisco Peninsula. Sj-6629.

DESIGN ENGINEER, mechanical or civil, with P.E. license and at least 5 years' supervisory design and specification experience on heating, ventilating and air conditioning construction. $7,800-$9,100. Long Island, N.Y. W-959.

CIVIL OR ARCHITECTURAL ENGINEER, graduate, with professional license or equivalent qualifications. Experience in building design and construction or in structural research together with the ability to prepare technical publications. East. W-951.

MANAGEMENT PERSONNEL. (*a*) Director of Operations, executive ability, with construction experience, cost accounting, experience and familiarity with IBM machinery desired, for the complete management of a central office of a medium sized highway and heavy contracting firm. (*b*) Concrete Plant Manager with thorough knowledge of manufacturing concrete, for the complete management of a small concrete plant. (*c*) Manager of Bituminous Concrete Plant, with a thorough knowledge of bituminous concrete paving, for the complete management of the operation from estimating through construction to final cost accounting. Salary open depending upon experience. East Coast. W-943.

MANAGER OF BRIDGE DEPARTMENT with a thorough knowledge of bridge and heavy structures, for complete management from estimating through construction to final cost accounting of small bridges. Also construct substantial amounts of curb and gutter, slope protection, etc. which operations will be under bridge division. Salary open, depending upon experience. East Coast. W-942.

RESEARCH AND TEACHING, Ph.D. required, with outstanding record of current research in civil engineering. Primary responsibilities will be organization of new research program and administration of graduate students. Salary and rank dependent upon qualifications. South. W-908.

ENGINEERS. (*a*) Structural Designer, civil graduate, with experience on steel and concrete highway bridges. $7,800. (*b*) Highway Designer, civil graduate, with experience on highway design including alignment, grading and drainage. $7,200-$7,800. (*c*) Inspectors with highway construction experience. $6,500-$7,200. Long Island, N.Y. W-907.

CONSTRUCTION EXECUTIVE, graduate mechanical or civil, with knowledge of construction procedures, costs, labor production and construction personnel, both subcontractors and company employees. Will be responsible for setting up, directing and coordinating field activity of subcontractors and company employees. Construction operations include shopping centers, supermarkets, industrial buildings. Salary open. Central New England. W-900.

CIVIL ENGINEER, JUNIOR, for design and field layout of industrial minerals plant and equipment. $6,000-$7,000. West Virginia. W-894(*a*).

STRUCTURAL CIVIL ENGINEER, graduate, knowledge of structural design essential. Knowledge of concrete structures, preferably on the construction of nuclear blast resistant structures, high calibre, sales background desirable. Good salary. New York Metropolitan area. W-887.

STRUCTURAL DESIGNER, graduate, 35 to 45; to design cement concrete batching plants and their related components for a steel fabricator. Must have good design knowledge of bins and hoppers, bucket elevators, screw conveyors and weigh batchers. Will direct supervision of engineering section responsible for structures and coordinate this work with the mechanical and electrical sections. Must be registered engineer. Employer will negotiate placement fee. $9,000-$10,000 depending on experience. Ohio. C-8922-Chicago.

SOILS ENGINEER AND FOUNDATION ENGINEER, M.S.C.E. in field of soils mechanics. Should have 1 or more years of engineering experience in soils and foundations. About $9,000, depending on experience. Nebraska and Iowa area. C-8876-Chicago.

PROCEEDINGS AVAILABLE

NOVEMBER

Journals: Hydraulics, Power, Sanitary Engineering, Waterways and Harbors.

2976. Dual Channel Stream Monitor, by S. S. Karaki, E. E. Gray, and J. Collins. (HY) The dual channel stream monitor, developed as a laboratory tool to aid hydraulic research, is an ultrasonic instrument for monitoring water surface and stream bed profiles simultaneously under dynamic conditions in an alluvial channel.

2977. Calculation of Potential Flows with Free Streamlines, by Garrett Birkhoff. (HY) A survey of methods for computing three classes of time-independent incompressible potential flows with free streamlines is given.

2978. Study of Scour Around Spur-Dikes, by R. J. Garde, K. Subramanya, and K. D. Nambudripad. (HY) This paper describes laboratory experiments on scour around spur-dikes placed in an alluvial channel.

2979. Penstocks and Scroll Cases for Niagara Power Project, by J. Edgar Revelle and John N. Pirok. (PO) The Power Authority of the state of New York channelled water from the Niagara River above the Falls to 25 generating units at Lewiston, N.Y., with a total installed capacity of 2,190,000 kw.

2980. Stabilization of the Middle Rio Grande in New Mexico, by Robert C. Woodson. (WW) The Middle Rio Grande in New Mexico is being stabilized by use of the steel Kellner Jetty System, by the Corps of Engineers, and by the Bureau of Reclamation.

2981. Queuing Theory and Simulation in Reservoir Design, by Myron B. Fiering. (HY) The theory of queues, or waiting lines, and Monte Carlo techniques are applied to the problem of selecting the optimal design of a multi-purpose reservoir.

2982. Cyclical Variations in World-Wide Hydrologic Data, by Gordon R. Williams. (HY) Short and long-term sunspot cycles are compared with variations in world precipitation, while runoff records are expressed as ratios to the mean and as cumulative deviations.

2983. General Solution for Open Channel Profiles, by James A. Liggett. (HY) A method for computing open channel profiles that may be used generally is presented and illustrated by numerical examples.

2984. Stability of Alluvial Channels, by Francis M. Henderson. (HY) Relationships are established between Lacey's regime theory and the Shields and Einstein formulas as a basis for a more rational approach to canal design problems and the study of channel formation in natural rivers.

2985. Reclaiming Hyperion Effluent, by Finley B. Laverty, Ralph Stone, and Lawrence A. Myerson. (SA) The results of three years of continuous tests on reclaiming the Los Angeles Hyperion Plant sewage effluent for recharge well injection is described.

2986. Coliform Organisms as an Index of Water Safety, Progress Report, Committee on Public Health Activities. (SA) A study of the question of suitability of the coliform organism for judging the sanitary quality of drinking water indicates that drinking water meeting present standards has not been proven the source of water-borne disease.

2987. Bank and Levee Stabilization, Lower Colorado River, by John S. McEwan. (WW) The experiences of the USBR with problems of levee protection, bank erosion, and sedimentation on the Lower Colorado River from 1905 to 1961 and various methods for the placement of revetting materials are presented.

2988. Non-Linear Tidal Flows and Electric Analogs, by James A. Harder and Frank D. Masch, Jr. (WW) The use of electrical analogs in the investigation of non-linear tidal systems is illustrated by an electrical model of the proposed sea-level Panama Canal, and the use of non-linear elements in the analog for accurate descriptions of wave forms is examined.

2989. Land and Water Resource Planning in Texas, by Charles D. Curran and Forney W. Fleming. (WW) The United States Study Commission-Texas, a new approach by the Federal Government of coordinating Federal, state, and local interests for areawide planning for land and water resources, is examined.

2990. Total Sediment Transport in the Lower Colorado River, by John R. Sheppard. (HY) Methods and results of a total sediment load sampling program by the United States Bureau of Reclamation on the Lower Colorado River between Davis Dam and Imperial Dam.

2991. Eddy Forces on Rigid Cylinders, by A. D. K. Laird. (WW) Potential theory is used to approximate forces caused by parallel neighboring cylinders and their eddies on a vertical circular cylinder in waves.

2992. Theoretical and Practical Aspects of Well Recharge, by Paul Baumann. (HY) Hydraulically, a recharge well is far more complex than a water well in reverse. Its performance must be understood and success may be affected by practical features, such as construction.

2993. Fish Handling Facilities for Baker River Project, by Warner W. Wayne, Jr. (PO) Describes the unique structures and equipment provided for collecting and transporting upstream and downstream migrant salmon past the two relatively high concrete dams in the Baker River.

2994. Navy's New Carrier Berthing Facilities at San Diego, by D. R. Forrest and John B. Stetson. (WW) The planning and construction of the Navy's new berthing facilities for Forrestal-class aircraft carriers at San Diego are described.

2995. Current Developments in Hydroelectric Plant Design, by William H. Wolf. (PO) A resume of developments in hydroelectric plant design is presented. Scope of design is reviewed as it affects site studies, plant layout, structural problems, and preparation of costs.

2996. Jet Discharge into a Fluid with a Density Gradient, by William E. Hart. (HY) Effects of turbulent liquid jets, the primary fluid, discharging upward into liquid of greater density are determined.

2997. Effects of Water Temperature on Stream Reaeration, Thirty-first Progress Report, Committee on Sanitary Engineering Research. (SA) A series of experiments were conducted to evaluate the temperature coefficient, θ, and the reaeration coefficient, k_2, in order to study the effect of water temperature on stream reaeration rates.

2998. Underground Power Plants in Yugoslavia, by V. M. Yevdjevich. (PO) Yugoslavia has twelve undergound water-power plants in operation and three under construction. Most are constructed in limestone, and the plant chamber is generally near the face of the mountain.

2999. Discussion of Proceedings Papers 2568, 2569, 2579, 2714, 2850, 2852, 2856. (PO) L. R. Scrivner on 2568. Merlin D. Copen on 2569. Robert Alexander on 2579. D. Hugh Trollope, Ian K. Lee, and Robert E. White on 2714. George A. Whetstone on 2850. Erik Rettig on 2852. C. H. Clay on 2856.

3000. Discussion of Proceedings Papers 2577, 2772, 2776, 2814, 2816, 2823, 2849, 2865. (HY) Neal E. Minshall on 2577. David W. Appel, Charles L. Sanford, and H. L. Uppal on 2772. Eduardo Basso on 2776. Jan-Inge Kveisengen, N. Rajaratnam, and Mikio Hino on 2814. C. F. Nordin, Jr., J. K. Culbertson, Alan V. Jopling, Vito A. Vanoni, and John F. Kennedy on 2816. Jamil Malaika, T. Blench, Donald R. F. Harleman, Ralph R. Rumer, Jr., Walter Rand, Jacob W. Davidian, Rolland W. Carter, and John A. Roberson on 2823. Steponas Kolupaila on 2849. M. D. Lester on 2865.

3001. Upflow Solids Contact Basin, by A. W. Bond. (SA) Methods of separating solids from water in water treatment processes and value of "solids contact" are considered, and an example of design of a simple upflow basin is given.

3002. Research on Composting of City Refuse and Nightsoil, by Yonosuke Kaibuchi. (SA) Evaluates two types of high rate mechanical digesters and forced air curing bins, using a pilot and a proto-type plant to study composting of city refuse.

ASCE SERVICE DEPARTMENT

1 TO CHANGE YOUR ADDRESS

Attention ASCE members:

Did you change jobs or receive a new title?

Did you move or do you anticipate a move in the near future?

If so, help us to do a better job for you. Complete and return this form to ASCE, United Engineering Center, 345 E. 47 St., N.Y. 17, N.Y.

For Address Change only.....
Give Old City and State Only

1 ASCE MAIL AND BUSINESS ADDRESS RECORD

Send Mail and Publications to: Business Address ☐ Residence Address ☐

Name.....
Last Name (Please Print) First Name Middle Name

Residence Address.....
Street City State

Name of Firm or Organization.....

Position or Title.....

Business Address.....
Street City State

Nature of Firm's Business.....
Product, Business or Service (Not for Publication)

2 TO REGISTER IN TECHNICAL DIVISIONS

ASCE members may register in two Technical Divisions and receive automatically all papers sponsored by those Divisions. Such registration will be effective 30 days after receipt by ASCE of this enrollment form.

2 DIVISION ENROLLMENT FORM

(For ASCE member use only)

Please change my Division Enrollment to.....

and.....(ONLY TWO) Cancel all others.

City.....Zone.....State.....

Signature.....

Name.....Membership Grade.....
(Please Print)

3 TO ORDER PROCEEDINGS PAPERS

To order Proceedings Papers, fill in this mailing label, indicating by number the papers desired. Cut out and mail to ASCE. Please print clearly.

3 MAILING LABEL FOR PROCEEDINGS PAPERS

(For ASCE member use only)

Name.....Membership Grade.....
(Please Print)

Street.....

City.....Zone.....State.....

Paper Numbers:

Members are entitled to receive free 100 different individual Proceedings Papers for each year ending Sept. 30. Additional copies and papers ordered in excess of the free allotment will be billed at the rate of 25 cents per copy. Non-members may order papers by remitting 50 cents per copy; members of Student Chapters, 25 cents per copy. Standing orders for all papers in a calendar year may be entered at the rate of $15 for ASCE and Student Chapter members, $25 for public and school libraries, and $40 for non-members.

KEY TO TECHNICAL DIVISIONS

(AT) Aero-Space Transport	(HW) Highway	(SA) Sanitary Engineering
(CP) City Planning	(IR) Irrigation and Drainage	(SM) Soil Mechanics and Foundations
(CO) Construction	(PL) Pipeline	(ST) Structural
(EM) Engineering Mechanics	(PO) Power	(SU) Surveying and Mapping
(HY) Hydraulics	(PP) Professional Practice	(WW) Waterways and Harbors

PROFESSIONAL SERVICES

EASTERN

JOHN J. MOZZOCHI and ASSOCIATES
Civil Engineers
Highways—Airports—Developments
Survey—Design—Inspection
217 Hebron Avenue, Glastonbury, Conn. — **200 Dyer Street, Providence, R.I.**

IS YOUR CARD AMONG THESE?
IT SHOULD BE
Write Today for Rates

J. E. GREINER COMPANY
Consulting Engineer
General engineering services for heavy engineering construction projects, such as bridges, tunnels, highways, airports, dams, waterfront facilities, defense installations, and engineering management as applicable to projects financed by revenue bonds; general consultation, reports, design, supervision of construction, maintenance and operation.
1106 N. Charles St., Baltimore, Maryland

KNOERLE, GRAEF, BENDER & ASSOCIATES, INC.
Consulting Engineers
Highways, Bridges, Airports, Water-front Structures
210 N. Calvert St., Baltimore 2, Maryland
211 W. Wacker—Chicago 6—Illinois
Judge Building—Salt Lake City, Utah

WHITMAN, REQUARDT AND ASSOCIATES
Engineers
Sewerage and Water Systems, Highways Airports, Industrial and Power Plants and Other Structures
Reports • Designs • Specifications • Supervisor
1304 St. Paul Street — **Baltimore 2, Md.**

MADDOX AND HOPKINS
Engineers and Surveyors
Plane and Geodetic Surveys
Topographic Maps • Photogrammetry
Highways, Utilities, Structures
8306 Dixon Ave. — **Silver Spring, Md.**

CAMP, DRESSER and McKEE
Consulting Engineers
Water Works and Water Treatment
Sewerage and Sewage Treatment
Municipal and Industrial Wastes
Investigations and Reports
Design and Supervision
Research and Development
Flood Control
18 Tremont Street — **Boston 8, Mass.**

CLARKESON ENGINEERING COMPANY, INC.
Highways, Bridges, Structures, Airports, Dams, Traffic Surveys, Reports, Waterfront Facilities, Soils, Foundations, Sewerage, Construction Supervision
285 Columbus Avenue, Boston 16, Mass.

FAY, SPOFFORD & THORNDIKE, INC.
Engineers
Industrial Plants — Incinerators
Water Supply, Sewerage, Drainage
Bridges — Express Highways
Port and Terminal Work — Airports
Boston, Mass.

JACKSON & MORELAND, INC.
JACKSON & MORELAND INTERNATIONAL, INC.
Engineers and Consultants
Electrical • Mechanical • Structural
Design and Supervision of Construction for
Utility, Industrial and Atomic Projects
Surveys • Appraisals • Reports
Technical Publications
Boston—Washington—New York

CHARLES A. MAGUIRE & ASSOCIATES
Engineers
Water Supply • Sewerage • Drainage
Highways • Bridges • Airports
Commercial and Industrial Buildings
Waterfront Facilities • Dams
Reports • Design • Supervision
Boston • Providence • Hartford

METCALF & EDDY
Engineers
Soils, Foundations, Waterworks, Sewage Works, Drainage, Irrigation, Flood Control, Refuse, Industrial Wastes, Airports, Highways, Military Projects, Industrial and Commercial Facilities
Statler Bldg., Boston 16, Massachusetts

The Thompson & Lichtner Co., Inc.
Civil and Industrial Engineers
Design, Supervision, Testing, Engineering and Production Studies, Special Structures, Tunnels, Airports, Highways, Foundations
Office and Laboratory • Brookline, Mass.

CRANDALL DRY DOCK ENGINEERS, INC.
Railway Dry Docks, Floating Dry Docks
Basin Dry Docks, Shipyards, Port Facilities
Investigation, Reports, Design
238 Main St. — **Cambridge 42, Mass.**

GOODKIND & O'DEA
Consulting Engineers
Design and Supervision
Foundations, Structures, Highways
610 Bloomfield Ave., Bloomfield, N. J.
1214 Dixwell Avenue, Hamden, Conn.
325 Spring Street, New York, New York
108 W. Lake St., Chicago 1, Illinois

JOSEPH S. WARD
Consulting Soil and Foundation Engineer
Site Investigation, Boring Supervision, Laboratory Soil Testing, Foundation and Pavement Analysis and Design, Construction Supervision, Engineering Reports and Consultation
91 Roseland Avenue — **Caldwell, N. J.**
Jefferson Building — **Phila. 7, Pa.**

EDWARDS AND KELCEY
Engineers and Consultants
TRAFFIC TRANSPORTATION PARKING
EXPRESSWAYS AIRPORTS PUBLIC WORKS
Surveys—Reports—Design—Supervision
3 William Street, Newark 2, New Jersey
Boston — **Salt Lake City** — **New York**
Providence — **Minneapolis**

PORTER & O'BRIEN
O. J. Porter & Co.
Consulting Engineers
Airports • Highways • Dams • Structures
Foundations • Stabilization • Pavements
415 Frelinghuysen Ave., Newark 5, N. J.
4201 Sunset Blvd., Los Angeles 29, Cal.
1421 47th Ave., Sacramento 22, Cal.

USE THIS PROFESSIONAL CARD DIRECTORY

Participation is restricted to consulting engineering firms operated or controlled by ASCE members.

AMMANN & WHITNEY
Consulting Engineers
Design and Construction Supervision of Bridges, Highways, Expressways, Buildings, Special Structures, Airport Facilities
111 Eighth Avenue, New York 11, N. Y.
724 E. Mason St., Milwaukee 2, Wisc.
1320 Connecticut Avenue, N.W. Washington 6, D. C.

BARSTOW & MULLIGAN
Engineers
Bridges, Highways, Parks
49 West 45th Street
New York 36, New York

BLAUVELT ENGINEERING CO.
Consulting Engineers
Highways — Bridges
Reports — City Planning
Municipal Engineering
New York, N. Y. — **Philadelphia, Pa.**
Woodbury, N. J. — **Crystal Lake, Ill.**

CLINTON BOGERT ENGINEERS
Consultants
Charles A. Manganaro **Robert A. Lincoln**
Ivan L. Bogert **William Martin**
Water & Sewage Works — Incinerators
Drainage — Flood Control
Highways and Bridges — Airfields
145 East 32nd Street, New York 16, N. Y.

BOWE, ALBERTSON & ASSOCIATES
Engineers
Water and Sewage Works • Industrial Wastes • Refuse Disposal • Valuations • Feasibility Reports • Laboratory Service
75 West Street
New York 6, N. Y.

BUCK, SEIFERT AND JOST
Consulting Engineers
Water and sewage works, industrial wastes disposal, hydraulic developments, dams, flood control. Chemical and biological laboratory
112 East 19th Street, New York 3, N. Y.

FARKAS & BARRON
Consulting Engineers
Designs • Supervision • Reports • Highways Expressways • Bridges • Housing • Public, Commercial and Industrial Buildings • Special Structures, Marine Structures • Airports
5 Beekman Street, New York 38, N. Y.
11 Commerce Street, Newark, N. J.
173 West Madison Street, Chicago, Illinois
7 Adelaide Street East, Toronto, Canada

GIBBS & HILL, INC.
Consulting Engineers
Water, Sewage & Industrial Waste Treatment Works—Roads, Bridges & Railroads—Conventional & Nuclear Power Generation—Electric Transmission & Distribution Systems—Industrial & Communication Facilities.
Pennsylvania Station
New York 1, N. Y.

HARDESTY & HANOVER
Consulting Engineers
Bridges • Fixed & Movable
Highways • Expressways, Thruways
Special Structures
Design, Supervision, Inspection, Valuation
101 Park Avenue • New York 17, N. Y.

FREDERIC R. HARRIS, INC.
Consulting Engineers
New York, N. Y.
Norwalk, Conn. — **New Orleans, La.**
Toronto, Canada — **The Hague, Holland**

HAZEN AND SAWYER
Engineers
Richard Hazen — Alfred W. Sawyer
H. E. Hudson, Jr.
Water and Sewage Works
Industrial Waste Disposal
Drainage and Flood Control
360 Lexington Ave., New York 17, N. Y.

JOHN J. KASSNER & CO.
Consulting Engineers
Highways, Bridges, Structures • Sewerage and Drainage • Waterfront Construction
Site Engineering and Recreational Facilities
Reports, Designs, Contracts and Specifications, Supervision of Construction
6 Church Street — **New York 6, N. Y.**

KING & GAVARIS
Consulting Engineers
ASSOCIATES: David Carsen
Dr. G. P. Tschebotarioff
Dr. Charles Tung
Sidney Zecher
Bridges, Highways, Tunnels
Waterfront Structures, Reports
Investigations, Foundations
Design & Supervision of Construction
41 East 42nd Street, New York 17, N. Y.

LEGGETTE, BRASHEARS & GRAHAM
Consulting Ground Water Geologists
Water Supply, Salt Water Problems, Dewatering, Recharging, Investigations, Reports
551 Fifth Avenue, New York 17, N. Y.

MORAN, PROCTOR, MUESER & RUTLEDGE
Consulting Engineers
Foundations for Buildings, Bridges and Dams, Tunnels, Bulkheads, Marine Structures, Soil Studies and Tests, Reports, Design and Supervision
415 Madison Ave., New York 17, N. Y.
Phone: EL 5-480

Is Your Card Among These?
It Should Be
Write Today For Rates

STEPHEN M. OLKO
Consulting Engineers
Reports and Designs
Soil Mechanics—Foundations
Marinas—Port Facilities
Structures—Highways—Airfields
50 E. 42 Street, New York 17, New York
OXford 7-1686

PARSONS, BRINCKERHOFF, QUADE & DOUGLAS
Engineers
Bridges, Highways, Tunnels, Airports, Port and Harbor Works, Transportation, Parking, Traffic Studies, Power, Dams, Flood Control, Sewerage, Water Supply.
165 Broadway, New York 6, N. Y.
833 Market Street, San Francisco 3, Cal.

E. LIONEL PAVLO
Consulting Engineer
Design, Supervision, Reports
Bridges, Highways, Expressways
Marine Structures, Industrial Construction
Public Works, Airports
642 Fifth Avenue New York 19, N. Y.

MALCOLM PIRNIE ENGINEERS
Malcolm Pirnie Carl A. Arenander
Ernest W. Whitlock Malcolm Pirnie, Jr.
Robert D. Mitchell Alfred C. Leonard
MUNICIPAL AND INDUSTRIAL
Water Supply—Waste Treatment
Sewage and Waste Treatment
Drainage—Rates—Refuse Disposal
522 Fifth Ave., New York 36, N. Y.
3013 Horatio Street, Tampa 9, Florida

THE PITOMETER ASSOCIATES, INC.
Engineers
Water Waste Surveys
Trunk Main Surveys
Water Distribution Studies
Water Measurement and Special Hydraulic Investigations
New York, 50 Church St.

ALEXANDER POTTER ASSOCIATES
Consulting Engineers
Water Works Sewerage, Drainage, Refuse Incinerators, Industrial Wastes, City Planning
50 Church Street New York 7, N. Y.

PRAEGER • KAVANAGH
Engineers
126 East 38th St. New York 16, N. Y.

SEELYE STEVENSON VALUE & KNECHT
Consulting Engineers
Richard E. Dougherty, Consultant
Civil—Structural
Mechanical—Electrical
101 Park Avenue New York 17, N. Y.

SEVERUD • ELSTAD • KRUEGER • ASSOCIATES
Consulting Engineers
Structural Design • Supervision • Reports
Buildings • Airports • Special Structures
415 Lexington Ave., New York 17, N. Y.

OLE SINGSTAD
Consulting Engineer
Vehicular and Railroad Tunnels, Subways, ventilation, expressways, Parking garages, airfields, Foundations, waterfront structures.
24 State St. New York 4, N. Y.

FREDERICK SNARE CORPORATION
Engineers • Contractors
Harbor Works, Bridges, Power Plants
Dams, Docks and Foundations
233 Broadway, New York 7, N. Y.
Havana, Cuba Lima, Peru
Bogota, Colombia Caracas, Venezuela

STEINMAN, BOYNTON, GRONQUIST & LONDON
Consulting Engineers
Highways—Bridges—Structures
117 Liberty Street, New York 6 ,N. Y.

TIPPETTS • ABBETT • McCARTHY • STRATTON
Engineers and Architects
Ports, Harbors, Flood Control Irrigation
Power, Dams, Bridges, Tunnels
Highways, Railroads
Subways, Airports, Traffic, Foundations
Water Supply, Sewerage, Reports
Design, Supervision, Consultation
375 Park Avenue, New York 22, N. Y.

ARNOLD H. VOLLMER ASSOCIATES
Consulting Engineers
Highways, Parks, Bridges, Municipal Improvements, Public Works, Reports, Surveys, Contract Plans
25 West 45th Street
New York 36, New York
Telephone: Circle 7-6250

LAWRENCE S. WATERBURY
Consulting Engineer
26 Broadway
New York 4, N. Y.
Bowling Green 9-9298

ROMAN WOLCHUK
Consulting Engineer
Bridges—Structures
Design—Reports—Investigations
Stress Analysis
307 Fifth Avenue, New York 16, N. Y.
MUrrayhill 4-2390

LOCKWOOD, KESSLER & BARTLETT, INC.
Civil Structural Sanitary Consultants
Research, Reports, Designs, Supervision
Photogrammetric Mapping
Seismic Sub-Surface Investigations
One Aerial Way, Syosset, New York
San Juan, P. R. Bogota, Columbia
Washington, D. C.

CAPITOL ENGINEERING CORPORATION
Consulting Civil Engineers
Dillsburg, Pennsylvania, U.S.A.

GANNETT FLEMING CORDDRY & CARPENTER, INC.
Engineers
Dams, Water Works, Sewage, Industrial Waste and Garbage Disposal • Highways Bridges and Airports, Traffic and Parking • Appraisals, Investigations, and Reports
HARRISBURG, PENNA.
Pittsburgh, Pa. Philadelphia, Pa.
Daytona Beach, Fla.

MODJESKI AND MASTERS
Consulting Engineers
Bridges, Highways, Structures
Special Foundations
Reports Inspections
Design
Supervision of Construction
900 Sixth St. New Orleans, La.
Harrisburg, Pa. Philadelphia, Pa.

AERO SERVICE CORPORATION
Integrated surveying and mapping services—including soils and sub-surface studies—for Highways, Water Supply, Dams, Airports, Municipal Developments, and other large engineering projects. Also associated electronic computing services.
210 E. Courtland St., Philadelphia 20, Pa.

ALBRIGHT & FRIEL, INC.
Consulting Engineers
Water, Sewage, Industrial Wastes and Incineration Problems, City Planning, Highways, Bridges and Airports, Dams, Flood Control, Industrial Buildings, Investigations, Reports, Appraisals and Rates
Three Penn Center Plaza, Phila. 2, Pa.

JUSTIN & COURTNEY
Consulting Engineers
Joel B. Justin Neville C. Courtney
Dams and Power Problems
Hydro Electric Developments
Foundations
121 S. Broad St. Philadelphia 7, Pa.

H. A. KULJIAN & COMPANY
Engineers and Architects
Power Plants (steam, hydro, nuclear
Industrial Buildings • Army & Navy Installations • Airports, Hangars
Water and Sewage Works
Design • Investigations • Reports • Surveys
1200 No. Broad St. Phila. 21, Pa.

HUNTING, LARSEN & DUNNELLS
Engineers
Industrial Plants • Warehouses
Commercial Buildings • Office Buildings
Laboratories • Steel and Reinforced Concrete Design • Supervision
Reports
1150 Century Bldg., Pittsburgh 22, Pa.

MORRIS KNOWLES INC.
Engineers
Water Supply and Purification
Sewerage and Sewage Disposal
Valuations, Laboratory, City Planning
1312 Park Bldg., Pittsburgh 22, Pa.

PENNSYLVANIA DRILLING COMPANY
Subsurface Explorations. Grouting
Industrial Water Supply. Mineral Prospecting
Large Diameter Drilled Shafts
Reports
1205 Chartiers Ave. Pittsburgh 20, Pa.

SWINDELL-DRESSLER CORP.
Consulting Engineers
Industrial Plants—Waterworks—Sewer Systems—Highways—Dams—Bridges—Surveys—Reports—Design and Construction Supervision
Box 1888 • Pittsburgh 30, Pa.

GILBERT ASSOCIATES, INC.
Engineers and Consultants
Surveys • Design • Supervision
Sanitary Engineering
Industrials and Utilities
Domestic and Foreign
525 Lancaster Avenue, Reading, Pa.
New York • Washington

PROFESSIONAL SERVICES

MICHAEL BAKER, JR., INC.

Consulting Engineers, Planners & Surveyors

Airport, Highway & Bridge Design; Water & Sewerage; Municipal Engineering; Photo Mapping; City Planning, Urban Renewal & Redevelopment; Soils Lab; Survey Service

HOME OFFICE—ROCHESTER, PA.
Baker Building
Jackson, Miss., Northview Drive
Charleston, W. Va., 19 Dunbar Street
Harrisburg, Pa., 2799 N. Fourth Street

SPRAGUE & HENWOOD, INC.

Foundation Investigations • Soil Testing and Test Borings • Grout Hole Drilling and Pressure Grouting • Diamond Core Drilling

Scranton, Pa. **New York, N. Y.**
Philadelphia, Pa. **Salt Lake City**
Pittsburgh, Pa. **Nashville, Tenn.**
Tucson, Ariz.
Buchans, Newfoundland

GIFFORD H. ALBRIGHT

Shelter Consultant

Fallout and Blast Resistant Shelters

Planning
Analyses
Special Studies

P.O. Box 675, State College, Pa.

ALSTER & ASSOCIATES, INC.
Engineers

Photogrammetric Engineering • Topographic Maps • Aerial Photography • Mosaics • Stock Pile Inventory • Plane & Geodetic Surveys • Land Acquisition Maps • Tellurometer and Geodimeter

6135 KANSAS AVENUE, N.E.
Washington 11, D. C. TA 9-1167

O'NEILL, SUPER, BEARD & Associates

Consulting Engineers

Specializing in Nuclear Protective Construction & Structural Analysis for Fallout Protection

Suite 400, 3000 Connecticut Ave., N.W., Washington 8, D. C.

WHITE-GREER ASSOCIATES

Architects, Engineers, and Planners

Overseas Projects

Airports, Communication Projects, Port Facilities, Public Works Projects, Industrial, Urban, Agricultural, and Rural Development

1145-19th St., N.W., Washington 6, D. C.

LASALLE
HYDRAULIC LABORATORY

Theoretical And Experimental Studies

Hydroelectric development, Municipal hydraulics, Hydraulics of special problems, Maritime hydraulics, Hydraulics of rivers, Industrial hydraulics, Hydraulic measuring instruments and field measurements.

0250, St. Patrick Str. LaSalle (P.Q.) Can.

MID-WESTERN

ALVORD BURDICK & HOWSON

Consulting Engineers

Water Works, Sewerage, Water Purification, Sewage Treatment, Flood Relief, Power Generation, Drainage, Appraisals

20 North Wacker Drive, Chicago 6, Ill.

CONSOER, TOWNSEND & ASSOCIATES

Water Supply, Sewerage, Flood Control and Drainage, Bridges, Express Highways, Paving, Power Plants, Appraisals, Reports, Traffic Studies, Airports, Gas and Electric Transmission Lines

360 E. Grand Ave., Chicago 11, Illinois
9½ Indiana St., Greencastle, Ind.

DeLEUW, CATHER & COMPANY

Consulting Engineers

Public Transit — Subways
Traffic & Parking — Railroad Facilities
Expressways — Industrial Plants
Grade Separations — Municipal Works
Urban Renewal — Port Development

150 North Wacker Drive, Chicago 6
San Francisco **New York** **Boston**

GREELEY AND HANSEN

Water Supply, Water Purification, Sewerage, Sewage Treatment, Refuse Disposal, Industrial Wastes

14 East Jackson Blvd., Chicago 4, Illinois

HARZA ENGINEERING COMPANY

Consulting Engineers

Hydroelectric Plants and Dams
Transmission Lines
Flood Control, Irrigation
River Basin Development

400 West Madison Street **Chicago 6**

C. MARTIN RIEDEL

Consulting Engineer

Chemical Soil Solidification Engineering for
Tunnels, Shafts, Mines, Foundations
Underground Structures

7650 S. Laflin St. **Chicago 20, Illinois**
29-27 41st Ave., Long Island City 1, N.Y.

SOIL TESTING SERVICES, INC.

Consulting Engineers

John P. Gnaedinger — Clyde N. Baker, Jr.

Sub-Surface Investigations, Laboratory Testing, Inspection, Engineering Reports and Design of Foundations

1827 No. Harlem Ave., Chicago 35, Ill.
Kenilworth, N. J.—San Francisco, Calif.
Vedado Hana, Cuba

STANLEY ENGINEERING COMPANY

Consulting and Design Engineers

Muscatine, Iowa
Chicago, Cleveland, Washington
Monrovia, Liberia, Lagos, Nigeria

JENKINS, MERCHANT & NANKIVIL

Consulting Engineers

Municipal Improvements — Gas Systems
Highways & Airports — Water Systems
Power Development — Sewerage Systems
Traffic Surveys — Industrial Plants
Flood Control — Recreational Facilities
Investigations and Reports

801-805 East Miller St. **Springfield, Ill.**

CLARK, DAILY & DIETZ

Consulting Engineers

James G. Clark — Jess C. Dietz
Eugene J. Daily — W. Don Painter

Expressways • Structures • Sanitary • Civil

211 N. Race, Urbana, Illinois
188 Jefferson, Memphis, Tennessee

NED L. ASHTON

Consulting Engineer

Aluminum and Steel Structures
Bridges and Paraboloidal Antennas
Swimming Pools and Foundations
Welded Design and Strengthening

820 Park Road **Iowa City, Iowa**

WALLACE & HOLLAND

Consulting Engineers

Civil—Sanitary—Structural

401 N. Federal **Mason City, Iowa**

SERVIS, VAN DOREN & HAZARD

Engineers-Architects

Investigations • Design • Supervision of Construction—Appraisals

Water • Sewage • Streets • Expressways
Highways • Bridges • Foundations • Airport
Flood Control • Drainage • Aerial Surveys
Site Planning • Urban Subdivisions
Industrial Facilities • Electrical • Mechanical

2910 Topeka Blvd. **Topeka, Kansas**

JOHNSON & ANDERSON, Inc.

Engineers

Sewerage & Sewage Treatment
Water Supply & Distribution—Bridges
Highways—Municipal Engineering
Flood Control and Drainage

Home Office: Pontiac, Michigan

Branch Offices:
Warren, Mich., and Flint, Mich.

BLACK & VEATCH

Consulting Engineers

Water, Sewage, Electricity, Gas, Industry, Reports Design Supervision of Construction Investigations, Valuation and Rates

1500 Meadow Lake Parkway
Kansas City 14, Missouri

BURNS & McDONNELL

Engineers-Architects-Consultants

4600 E. 63rd Street, Trafficway
Kansas City 41, Missouri

HOWARD, NEEDLES, TAMMEN & BERGENDOFF

Consulting Engineers

Bridges, Foundations, Airports
Administrative Services, Express Highways, Traffic and Parking

1805 Grand Ave. **99 Church St.**
K. C. 8, Mo. **N. Y. 7, N. Y.**
704 Standard Building
Cleveland 13, Ohio

SVERDRUP & PARCEL
SVERDRUP & PARCEL AND ASSOC., Inc.

Engineers-Architects

Bridges, Highways, Structures, Airports and Tunnels
Industrial and Power Plant Engineering
Municipal, Port and Railroad Facilities

915 Olive St., St. Louis 1, Mo.
417 Montgomery St.,
San Francisco 4, Calif.
111—8th Avenue, New York 11, N. Y.
1625 Eye St. NW, Washington 6, D. C.

HAZELET & ERDAL

Consulting Engineers

Design, Supervision, Investigations, Reports
Fixed Bridges — Movable Bridges
Expressway Systems — Harbor Works & Dams

Dixie Terminal Bldg., Cincinnati 2, O.
Monadnock Block, Chicago 4, Ill.
Oding Bldg., Lansing 33, Mich.
Commerce Bldg., Louisville 2, Ky.

VOGT, IVERS & ASSOCIATES

Engineers-Architects

Highways—Structures—Expressways
Industrial Bldgs.—Harbor Facilities
Airports—Dams—Surveys
Transportation Studies—Reports

34 W. Sixth St., Cincinnati 2, O.
20 N. Wacker Dr., Chicago 6, Ill.

THE AUSTIN COMPANY

Design • Construction • Reports • Plant Location Surveys • Domestic and Foreign Work

3650 Euclid Avenue, Cleveland, Ohio
New York **Detroit** **Oakland**
Chicago **Houston** **Seattle**
Los Angeles

HAVENS AND EMERSON

A. A. Burger — **F. S. Palocsay**
J. W. Avery — **G. H. Abplanalp**
E. S. Ordway — **S. H. Sutton**
A. M. Mock
Frank C. Telles, Consultant

Consulting Engineers

Water, Sewerage, Garbage, Industrial Wastes, Valuation, Laboratories

Leader Bldg. **Woolworth Bldg.**
Cleveland 14, O. **New York 7, N. Y.**

THE OSBORN ENGINEERING COMPANY

Designing • Consulting

Industrial Plants — Office Buildings
Stadiums — Grand Stands — Field Houses
Bridges — Docks — Laboratories

7016 Euclid Ave. **Cleveland 3, Ohio**

BENHAM ENGINEERING COMPANY

and Affiliates

Surveys Design & Supervision
of
Civil Mechanical Electrical
Sanitary Structural
Engineering Projects
and
All Types of Building Construction

215 N.E. 23rd St., Okla. City 5, Okla.
623 Guaranty Bank Bldg., Phoenix, Ariz.

USE THIS PROFESSIONAL CARD DIRECTORY

Participation is restricted to consulting engineering firms operated or controlled by ASCE members.

SOUTHERN

BROWN ENGINEERING COMPANY, INC.

Architects—Engineers

Civil • Mechanical • Electrical • Industrial
Highway Design — Structural Design
Water Supply — Airports
Sewage Disposal — Industrial Plants
Land Development — Bridges
Railroads — Reports
Commercial and Industrial Buildings

P. O. Drawer 917, Huntsville Alabama

Additional
Professional Cards on Pages 124, 125 and 127

PALMER & BAKER, ENGINEERS, INC.
Consulting Engineers and Architects
Tunnels, Bridges, Highways, Airports, Industrial Buildings, Harbor Structures, Soils, Materials and Chemical Laboratories
Mobile, Ala. New Orleans, La.
Washington, D. C.

EUSTIS ENGINEERING COMPANY
Foundation and Soil Mechanics Investigations
Soil Borings Laboratory Tests
Foundation Analyses Reports
3635 Airline Highway
Metairie, Louisiana

BEDELL & NELSON ENGINEERS, INC.
Consulting Engineers—Architects
Airports, Buildings & Industrial Structures, City & Site Planning, Harbor Structures Highways & Bridges, Industrial Plants, Municipal Improvements & Utilities, Reports, Estimates, Design, Supervision
1200 St. Charles Ave., New Orleans, La.

FROMHERZ ENGINEERS
Structural • Civil • Sanitary
Four Generations Since 1867
Water Supply, Sewerage, Structures, Drainage, Foundations, Industrial Waste Disposal, Investigations, Reports, Plants and Specifications, Supervision
816 Howard Avenue, New Orleans

ENGINEERS LABORATORIES, INC.
Foundation Engineers
Borings • Laboratory Tests • Analyses Earthwork, Concrete & Asphalt Field Control Engineering Reports & Recommendations
4171 Northview Drive
Jackson, Mississippi

WILLIAM F. GUYTON AND ASSOCIATES
Consulting Ground-Water Hydrologists
Underground Water Supplies Investigations, Reports, Advice
212 First Federal Savings Bldg.
221 E. 11 St., Austin 1, Texas
Phone: GR 7-7165

SPENCER J. BUCHANAN AND ASSOCIATES, INC.
Consulting Engineers
Soil Mechanics and Foundation Engineering, Earth Dams, Wharves, Airfields, Highways, Drainage, Structural Foundations; Reports, Design, and Field Supervision
310 Varisco Building, Bryan, Texas
Phone TAylor 2-3767

SOIL MECHANICS INCORPORATED
Foundation Exploration and Laboratory Testing Services
Site Investigations; Soil Borings; Field and Laboratory Testing of Soils, Concrete and Asphalt; Load Tests; Reports
310 Varisco Building, Bryan, Texas
Phone TAylor 2-3767

More and More Members of the Society are using this Service.
Is Your Card Here!

LOCKWOOD, ANDREWS & NEWMAN, INC.
Consulting Engineers
Founded 1935
CIVIL • STRUCTURAL • MECHANICAL
ELECTRICAL • INDUSTRIAL • MUNICIPAL
HYDRAULIC • COASTAL
Reports—Design—Valuations
3230 Reid Drive, Corpus Christi
1010 Waugh Drive, HOUSTON, Texas
202 E. Goodwin, Victoria

ETCO ENGINEERS AND ASSOCIATES FOUNDATION CONSULTANTS
Test Borings Laboratory Tests
Recommendations, Design and Supervision
2116 Canada Dry St., Houston 23, Texas
727 Main St., Baton Rouge, Louisiana
427 Carondelet St., New Orleans 12, La.

McCLELLAND ENGINEERS, INC.
6100 Hillcroft 201 Pine Street
HOUSTON, TEX. NEW ORLEANS, LA.
SOIL & FOUNDATIONS INVESTIGATIONS

WESTERN

ENGINEERS TESTING LABORATORIES, INC.
Warne-Sergent Engineers
Soil Mechanics and Foundation Engineers
2515 East Indian School Road
Phoenix, Arizona

ENGINEERING-SCIENCE, INC.
Design • Research • Planning
Water Supply Site Development
Sewerage Buildings
Flood Control Bridges
Municipal-Industrial
150 E. Foothill Blvd., Arcadia, Calif.
4144 Telegraph Ave., Oakland 9, Calif.

CLAY COLLEY
Consulting Engineer
Specializing in basic design of Material Handling and Dust Control Systems.
Reg. Eng. Calif., New Mex., Nev., Ore.
4032 McClung Drive
Los Angeles 8, Calif.

FOUNDATION ENGINEERING COMPANY
Investigation
Geology, Drilling, Field & Laboratory Testing
Tharalson Side Hole Sampler and Tester
Design
Soil Mechanics, Foundations, Earth Structures
Dams, Highways, Airports
219 W. 7th St. Los Angeles 14, Calif.
MAdison 2-4923

C. E. JACOB
Groundwater Consultant
Water Supply, Drainage, Dewatering, Subsidence, Recharging, Salt-Water Control, Statistical Hydrology, Digital and Analog Computation
P.O. Box 347 Northridge, Calif.
Cable JACOBWELL Los Angeles
Dickens 5-4990

DAMES & MOORE
Consultants in Applied Earth Sciences
Soil Mechanics Engineering Geology
Geophysics
Atlanta, Chicago, Honolulu, Houston
Los Angeles, New York, Portland
Salt Lake City, San Francisco
Seattle

KAISER ENGINEERS
Division of Henry J. Kaiser Company
Engineers • Contractors
Investigations • Reports • Valuations
Design • Construction
Crestview 1-2211
300 Lakeside Drive Oakland, Calif.

WOODWARD, CLYDE, SHERARD AND ASSOCIATES
Soil and Foundation Engineers
Oakland—San Diego—Denver—Omaha
Kansas City—St. Louis—Philadelphia
Montclair—New York
1150 28th Street, Oakland, California
680 Fifth Avenue, New York, N. Y.

INTERNATIONAL ENGINEERING COMPANY, INC.
Engineers
Investigations • Reports • Design
Procurement • Field Engineering
Domestic and Foreign
74 New Montgomery St.
San Francisco 5, California

JACOBS ASSOCIATES
Consulting Construction Engineers
Appraisal of Construction Costs • Methods Analysis • Field Engineering • Job Management • Review of Bidding Documents for Construction Economy • Engineering Geology • Plant and Equipment Design
503 Market Street
San Francisco 5, California

ROCKWIN ENGINEERS
Prestressed Concrete Consultants
Design Bridges
Checking Buildings
Investigations Waterfront Structures
Inspections Stadiums
Reports Specialties
Construction Supervision Prestressing Yard Facilities
13440 E. Imperial Highway, Santa Fe Springs, Calif. • UNiversity 8-1761

SHANNON AND WILSON
Soil Mechanics and Foundation Engineers
1105 North 38th Street
Seattle 3, Washington

FOREIGN

SACMAG
Engineers — Architects
55 Cervantes, San Juan, Puerto Rico
Texico City San Jose, Costa Rica
San Salvador Panama

LAURIE AND MONTGOMERIE
Consulting Engineers
J. J. Laurie, Reg. Struct. Eng. California
Investigations • Design • Supervision Site Development, Industrial Plants, Buildings, Special Structures, Roads, Water, Drainage, Sewage & Trade Wastes.
39 Pitt Street Sydney, Australia

AMMANN & WHITNEY
Consulting Engineers
111 Eighth Avenue, New York 11, N. Y.
Buildings, Industrial Plants, Airport Facilities Bridges, Highways, Special Structures
29 Rue de Pyramides, Paris, France
32 Patission Street, Athens, Greece
P.O. Box 1423, Tehran, Iran
P.O. Box 1498, Addis Ababa, Ethiopia

LOUIS BERGER & ASSOCIATES
Engineers – Architects
Highways, Bridges, Dams, Irrigation, Airfields Structures, Buildings, Industrial Plants, Military Installations, Foundations, Studies, Reports, Planning, Design, Supervision
177 Oakwood Avenue, Orange, N. J.
Harrisburg, Pa., Salt Lake City, Utah, Columbus, Ohio, Frankfurt-Main, Germany, Geneva, Switzerland, Madrid, Spain, Dacca, E. Pakistan, Kuala Lampur, Malaya, Hong Kong.

WHITE-GREER ASSOCIATES
Architects, Engineers, and Planners
Airports, Communication Facilities, Port Facilities, Public Works Projects, Industrial, Urban, Agricultural, and Rural Development
26 Avenue Trudaine, Paris 9, France,
32 rue des Noirettes, Geneva, Switzerland, 10 Avenue Bahar and Shahreza, Tehran, Iran.

USE THIS PROFESSIONAL CARD DIRECTORY

Participation is restricted to members or firms where one or more of the principals are members of the American Society of Civil Engineers

Your Card Should be Among Them • Write Today for Rates

Index to Advertisers

Acker Drill Co., Inc. 106
Wm. Ainsworth & Sons, Inc. 110
The Alpha Portland Cement Company 107
American Bitumuls & Asphalt Company 12
American Cast Iron Pipe Co. 17
American Steel & Wire Division of United States Steel Corporation ..... 82 and 83
Armour Research Foundation 119
The Asphalt Institute ..... 10 and 11
Associated Pipe & Fitting Company, Inc. 104

Bethlehem Steel Company ..... 1, 26 and 105
Borden Metal Products Co. 2
Brown & Brown, Inc. 104

Cast Iron Pipe Research Association ..... 90 and 91
Chicago Bridge & Iron Company 28
Clearprint Paper Co. ..... 2nd Cover
Concrete Reinforcing Steel Institute 118
Crown Zellerbach Corporation 19

Edo Corporation 110
The Eimco Corporation 4

Forney's Inc., Tester Division 18

Gregory Industries, Inc., Nelson Stud Welding Division ... 93

Rodney Hunt Machine Co. 92

Inland Steel Company ..... 22 and 23
International Business Machine Corp. ..... 76 and 77
Irving Subway Grating Co., Inc. 109

Jahn Forming Method 112

Kern Instruments, Inc. 118
Kerrigan Iron Works, Inc. 116

Lehigh Portland Cement Company 99
Lenker Manufacturing Company 112
Lock Joint Pipe Company ..... 4th Cover
Lone Star Cement Corporation 32

M & H Valve and Fittings Company 108
Martin-Marietta Corporation 87
Moretrench Corporation 116

Newport News Shipbuilding and Dry Dock Company 9
No-Joint Concrete Pipe Company 74

Phoenix Bridge Company 118
Pittsburgh-Des Moines Steel Co. 30
Portland Cement Association ..... 100 and 101
Posey Iron Works, Inc. 112
Prestressed Concrete Institute ..... 24 and 25

John A. Roebling's Sons Division The Colorado Fuel and Iron Corporation 89

Sika Chemical Corporation ..... 3rd Cover
Sonoco Products Company 114
Spencer, White & Prentis, Inc. 111
Symons Clamp & Mfg. Co. 18

Thiokol Chemical Corporation 85
E. A. Thompson Company 106

The Union Metal Manufacturing Co. 75
U. S. Pipe and Foundry Company ..... 20 and 21
United States Steel Corporation ....5, 6, 7, 8, 14, 15, 82 and 83
Universal Form Clamp Co. 104

Vibroflotation Foundation Co. 13

C. H. Wheeler Mfg. Co. 16
Wild Heerbrugg Instruments, Inc. 27
R. D. Wood Company 103

Advertising Manager

James T. Norton

Advertising Production Manager

Jerry Nussbaum

345 East 47th Street, New York 17, N. Y.

Representatives

EASTERN

- Robert S. Cypher
  345 East 47th Street, New York 17, N. Y.

SOUTHEASTERN

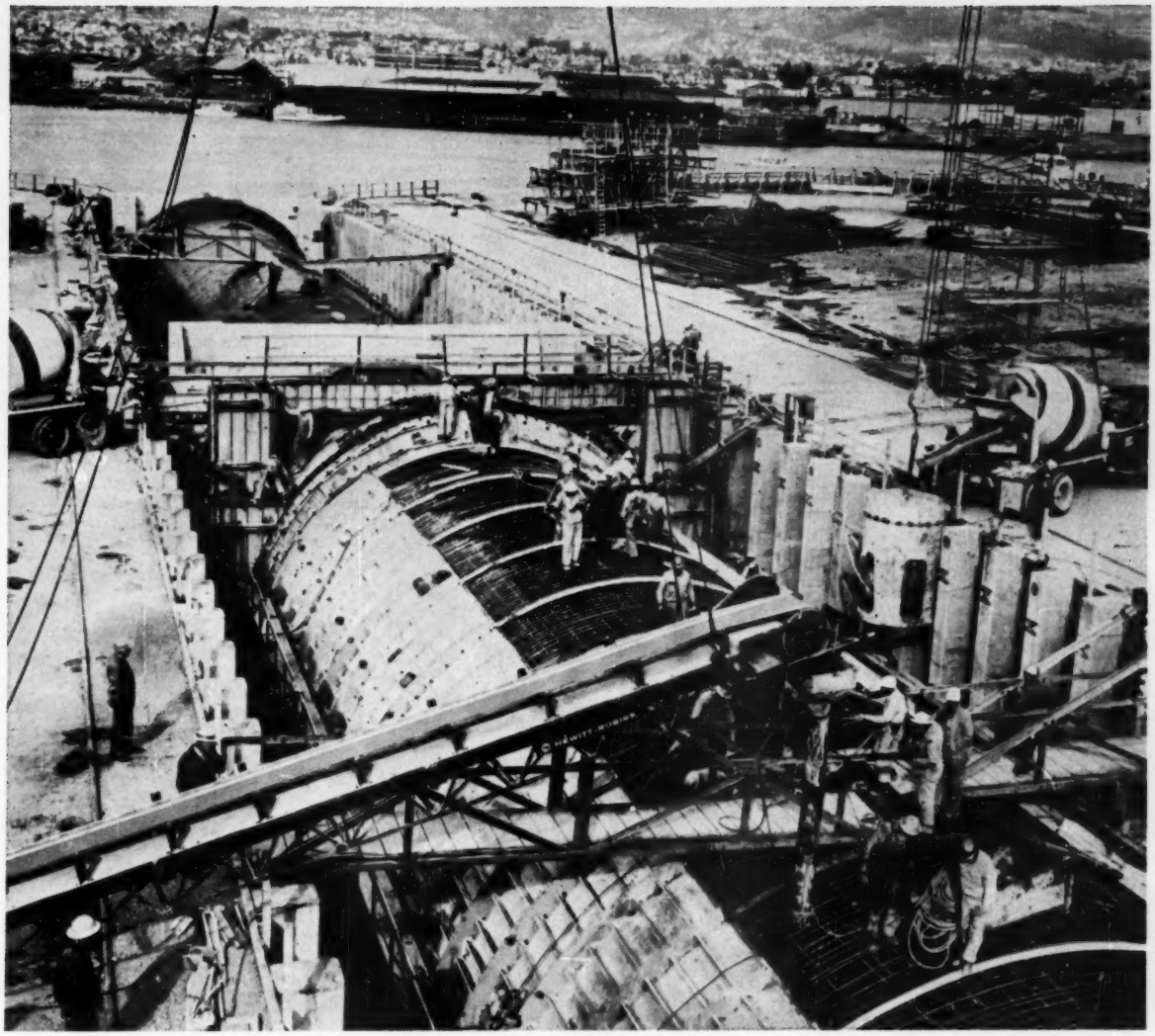
- Fred W. Smith
  P.O. Box 20060
  Birmingham 16, Ala.

MID-WESTERN

- Richard K. Holmstrom
  Suite 812, 29 East Madison St., Chicago 2, Ill.
- Frank X. Nugent
  Suite 1313, 75 Public Square, Cleveland 13, Ohio

WESTERN

- McDonald-Thompson, Inc.
  625 Market St., San Francisco 5, Calif.
  3727 West Sixth St., Los Angeles 5, Calif.
  National Bldg., 1008 Western Ave., Seattle 4, Wash.
  2035 S.W. 58th Avenue, Portland 1, Oregon
  3217 Montrose Boulevard, Houston 6, Texas
  620 Sherman Street, Denver, Colorado
  2727 Oak Lawn Avenue, Dallas 19, Texas



CREDITS: Owner, State of California, Department of Public Works, Division of Highways; Contractor, Pomeroy-Bates & Rogers-Gerwick.

Builders of Concrete Tubes Gain More Advantages with PLASTIMENT

In casting the twelve, 37-ft diameter, 200-ft long, segments of the new Webster Street Tunnel between Alameda and Oakland, California, the contractor chose **Plastiment**, the admixture which provided these specific advantages.

Increased workability at low slumps facilitated vibration and consolidation of the mix throughout the heavily-reinforced tubes. **Retarded set** extended the plastic period of the freshly-mixed concrete so that succeeding layers could be placed and vibrated together. **Rapid strength gain** speeded casting. Long-term advantages include **higher ultimate strength, minimum shrinkage** with consequent reduced cracking, and **greater uniformity.**

Plastiment is the admixture proven through years of on-the-job experience to provide specific and reliable advantages.

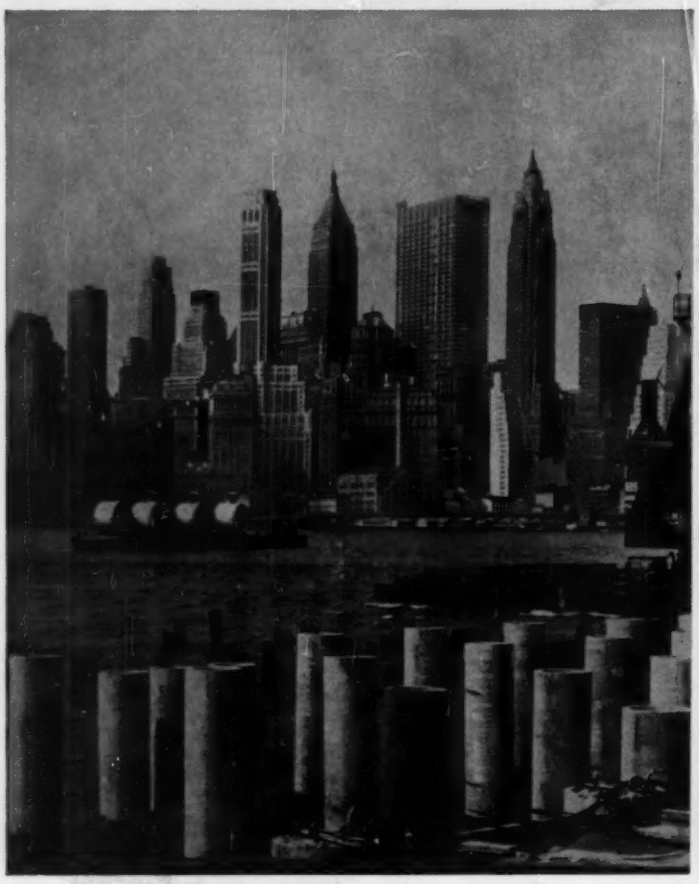
For full details about Plastiment Retarding Densifier, ask for your copy of Bulletin PCD-59. District offices and dealers in principal cities, affiliate manufacturing companies around the world. In Canada, Sika Chemical of Canada, Ltd.; in Latin America, Sika Panama, S.A.

Sika

SIKA CHEMICAL CORPORATION

Passaic, N. J.

METROPOLIS OR MOUNTAIN TOP



PILE SLEEVE OR PIPELINE

LOCK JOINT PIPE COMPANY products for a variety of purposes are offered on a world-wide market. The majestic New York skyline looks down on a bargeload of 144" Lock Joint Concrete Subaqueous Pipe en route to a metropolitan sewer outfall project, as well as on Lock Joint Concrete Pile Sleeves being installed for the Port Authority's pier construction program.

15,000 feet up on the bleak slopes of the Andes, the installation of 40 miles of Lock Joint Concrete Pressure Pipe made vital water available to the Southern Peru Copper Company's $300,000,000 mining enterprise.

So it is throughout the world. Lock Joint products are bringing fertility to the Negev Desert. Additional water flows to thriving Cape Town through a Lock Joint supply line. Lock Joint transmission and distribution mains as well as sewer lines help meet greatly increased demands in booming Caracas. These are only a few of the thousands of communities at home and abroad served with complete satisfaction by Lock Joint Pipe Company.

LOCK JOINT PIPE CO.

East Orange, New Jersey

Member of the AMERICAN CONCRETE PRESSURE PIPE ASSOCIATION

Sales Offices: Chicago, Ill. • Columbia, S. C. • Denver, Col. • Detroit, Mich. • Hartford, Conn. • Kansas City, Kan. • Perryman, Md. • St. Paul, Minn. • Winter Park, Fla.

Pressure • Water • Sewer • **REINFORCED CONCRETE PIPE** • Culvert • Subaqueous